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EPA Superfund
Record of Decision:

CIBA-GEIGY CORP. (MCINTOSH PLANT)
EPA ID: ALD001221902
OU 03
MCINTOSH, AL
07/25/1995

<IMG SRC 0495244>

RECORD OF DECISION

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

CIBA-GEIGY CORPORATION SUPERFUND SITE

OPERABLE UNIT #3 McINTOSH FACILITY

McINTOSH, WASHINGTON COUNTY, ALABAMA

PREPARED BY

U. S. ENVIRONMENTAL PROTECTION AGENCY

REGION IV

ATLANTA, GEORGIA

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OPERABLE UNIT #3 McINTOSH FACILITY

SITE NAME AND LOCATION

Ciba-Geigy Corporation Superfund Site
McIntosh, Washington County, Alabama

STATEMENT OF BASIS AND PURPOSE

This decision document (Record of Decision), presents the selected remedial action for OU #3 at the McIntosh Facility for the Ciba-Geigy Corporation Chemical Superfund Site, McIntosh, Alabama, developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) 42 U.S.C. Section 9601 et seq. and to the extent practicable, the National Contingency Plan (NCP) 40 CFR Part 300.

This decision is based on the administrative record for the Ciba-Geigy Corporation Chemical Superfund Site ("the Site").

The State of Alabama, as represented by the Alabama Department of Environmental Management (ADEM), has been the support agency during the Remedial Investigation and Feasibility Study process for the Ciba-Geigy Superfund Site. In accordance with 40 CFR 300.430, as the support agency, ADEM has provided input during this process. The State of Alabama concurs with the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances (pollutants or contaminants) from the Site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare and/or the environment.

DESCRIPTION OF SELECTED REMEDY

This operable unit is the final of four operable units at the Ciba-Geigy Site.

The major components of the selected remedy for operable unit three include:

- Excavation of approximately 2500 cubic yards of soil and sediment above the cleanup level, 15 ppm DDTR. 15 ppm DDTR has been determined to be the best balance of protection for the environment based upon our present knowledqe at the site. Excavated soil and sediment would be treated with the OU #2 and OU #4 soil if the concentrations is above 500 ppm DDTR.

- Soil excavated from the floodplain (OU #3) that is below 500 ppm DDTR may be used as subsurface backfill for excavated areas of OU #2. Prohibiting the placement of soil or sediment with concentrations greater than 500 ppm DDTR will ensure that subsurface treatment levels established in the OU #2 ROD for the protection of groundwater will not be exceeded. Based on the current information, the majority of the soil and sediment would be available to be used as subsurface backfill.

- Backfilling the excavated areas of the floodplain with clean fill.

- In-situ bioremediation of approximately 10 acres of the more ecologically sensitive areas (cypress swamp(s) and bottom land hardwood forest) that exceed the cleanup level if Ciba-Geigy demonstrates to EPA's satisfaction that in-situ bioremediation will provide sufficient and timely degradation of all DDTR without increasing the rate of methylation of mercury in areas where the wastes are commingled. If Ciba-Geigy is unable to demonstrate to EPA's satisfaction that in-situ bioremediation will achieve all of the remedial goals for the area(s), the area(s) will be addressed by objective #2 of the Remedial Design Study (below).

- Conducting Remedial Design studies to accomplish the following objectives:

    1. To provide the baseline levels which will be used to monitor the long-term effectiveness of the remediation;

    2. To determine if it is necessary to modify cleanup goals in different areas of the floodplain based on ecological sensitivity (i.e., To avoid the unnecessary destruction of habitats that may be irreplaceable by balancing the effects of the contaminants with the effects of the cleanup); and,

    3. To select appropriate species to be used for measuring the effectiveness of the remedy. To establish performance standards or maximum contaminant levels in those species to determine when site remediation is successful.

Based on the results of the Remedial Desiqn studies, the cleanup level may be adjusted.

If adjustments to the cleanup level are made, such adjustments will be published in a fact sheet, ESD, or ROD Amendment.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment or resource recovery technologies, to the maximum extent practictable. However, because treatment of the principal ecological threats of the site was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as the principal element. Finally, it is determined that this remedy maximizes long-term effectiveness.

Because this remedy would result in hazardous substances remaining on-site, a review would be conducted within five years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

<IMG SRC 0495244A>	<IMG SRC 0495244B>
Richard D. Green, Associate Director of Superfund and Emergency Response	DATE

Decision Summary of
Record of Decision

Ciba-Geigy Corporation
McIntosh, Alabama

1.0 SITE LOCATION AND DESCRIPTION

The Ciba-Geigy McIntosh facility is located two miles northeast of McIntosh, Alabama and approximately 50 miles north of Mobile, Alabama. The property is bounded by a pine forest to the north (Boykin property), Olin Corporation Property to the south, and the Tombigbee River to the southeast. The nearest residents are approximately 1.5 miles to the west and the south. Approximately 300 residents live within a 3 mile radius.

The entire Ciba-Geigy property encompasses approximately 1,500 acres, of which 1,130 acres (2.4 sq miles) consists of developed plant site. The remaining 370 acres consists of undeveloped swamp and bottomlands that comprise a portion of the Tombigbee River floodplain. The floodplain is separated from the developed portions of the plant property by a steep escarpment known as the "bluffline."

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FIGURE 1-1 LOCATION OF SITE

The portion of the floodplain owned by Ciba-Geigy Corporation has been modified from its pre-development condition beginning in 1952. In 1955, discharge from an effluent impoundment flowed along the southern edge of the manufacturing facility eastward toward the bluffline then discharged to the Tombigbee river via an effluent ditch which was constructed to convey the wastewater to the Tombigbee River. The river water pump station was constructed in 1962 to supply process water to the production facilities on the upland terrace.

In 1965, waste waters were routed through new impoundments for treatment. Effluent from the impoundments was discharged to the effluent ditch which was rerouted to its present-day location along the southern edge of the property to the Tombigbee River. The transporting of effluent from empoundments to the Tombigbee River and migration of contamination from nearby upland former waste management areas during periods of heavy rainfall or flooding were the primary sources of contamination in the floodplain. The nearby upland former waste management areas are a part of the OU#2 and OU#4 cleanup.

The effluent diffuser line was constructed in late 1968 to convey wastewater effluent and to provide a mixing mechanism for the effluent as it was discharged to the Tombigbee River. The pipeline diffuser section was anchored to the river bottom. The effluent diffuser line was taken out of service in late 1973 when the biological treatment system was constructed

In 1973, a biological treatment system was constructed east of the manufacturing area. From 1973 until 1988 all treated wastewater from the biological treatment system and all neutralized dilute wastewater and impounded stormwater from the dilute impoundment was discharged to the effluent ditch via gravity pipelines. These effluents were combined with once-through, non-contact cooling water in the effluent ditch to make up the plant's NPDES discharge. The effluent ditch remains in use for stormwater overflow. Treated effluent now traverses the floodplain in an enclosed elevated pipeline.

Two areas were identified in the floodplain which manifest evidence of vegetative stress. The largest area was located immediately below the bluff line and a second area was located adjacent to the first, southwest of the former effluent ditch. The vegetative stress was believed to have been caused principally by former soil erosion and deposition from the adjacent bluffline. Erosion from the bluffline area was halted in 1985 by stabilization of the escarpment with extensive rip-rap and improvement of the vegetative cover of the bluffline surface. At the time of the RI Field Investigations (1988), natural revegetation of the stressed areas had begun. The intervening years since that study have seen a marked increase in the area extent and density of vegetation in these areas.

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In 1986, portions of the floodplain property along the south road near the river were seasonally used to collect newly deposited river sediment which was used as top soil. The floodplain is well drained during periods of low water due to an active maintenance program in which drainage conduits and ditches are regularly cleaned of beaver dams and trapped debris which otherwise tend to retard the drainage in the floodplain. Aside from the effluent ditch and newer effluent conveyances, the floodplain has not been utilized for waste management.

In December 1988 the use of the effluent ditch as a conduit for treated wastewater was discontinued. An above-ground pipeline now conveys treated effluent from the new waste waster treatment system which was brought on line at that time. The effluent pipeline follows the course of the effluent ditch to the Tombigbee River. Approximately 500 feet before reaching the river, the diffuser line descends below ground and emerges on the river bottom where waste water is diffused along the width of the river.

The dominant surface water bodies in the region surrounding the Site are the Tombigbee and Alabama Rivers. The Tombigbee River is characterized as a large, meandering river surrounded by numerous oxbow lakes and wetlands. The Tombigbee River originates in northeastern Mississippi and flows 442 river miles south to its confluence with the Alabama River. The Tombigbee and Alabama Rivers form the Mobile River, which then flows south another 45 river miles until it empties into Mobile Bay in the Gulf of Mexico. The gentle regional slope has resulted in very broad floodplains along each of the rivers; large portions of the Tombigbee River Valley (including the floodplains in the vicinity of McIntosh) are flooded annually.

There are relatively few areas of ponded water within the study area that are wet enough to support aquatic life throughout the year. Within the Ciba-Geigy floodplain, these are limited to the stormwater drainage ditch (formerly the effluent ditch), which parallels the south floodplain road for most of its course in the floodplain, and the northern drainage ditch that parallels the north floodplain road. A drainage area below the bluffline contains water for most of the year. In addition to the Tombigbee River, the principal off-site aquatic habitats are the Olin drainage which includes a small cypress swamp, a connecting drainage way and associated depression, and Olin Basin, which is a lake occupying approximately 65 acres. Additional aquatic habitat is provided by Johnson Creek which flows seasonally through the northern portion of the Ciba-Geigy property onto the adjacent Boykin property where it has been dammed, creating a permanent water body. The only aquatic habitat of sufficient depth throughout the year to sustain populations of large fish is the Olin Basin and ponded portions of Johnson Creek.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Ciba-Geigy McIntosh facility, formerly owned by Geigy Chemical Corporation, began operations in October 1952, with the manufacture of one product, dichlorodiphenyl-trichloroethane (DDT). Though 1970, Geigy expanded its McIntosh faciities by adding the production of fluorescent brighteners used in laundry products; herbicided; insecticides; agricultural chelating agents; and sequestering agents for industry. In 1970, Geigy merged with Ciba (Chemical Industry in Basel, Switzerland), forming Ciba-Geigy Corporation.

The EPA Region IV Environmental Services Division of Athens, Georgia (ESD) conducted an investigation in August 1982 of the Olin Chemical Company located adjacent to the Ciba-Geigy Site. As a part of the investigation, ESD sampled a drinking water well on Ciba-Geigy property. This sampling indicated the presence of hazardous substances which warranted further evaluation of the contamination problem at Ciba-Geigy. In June 1983, the Hazardous Ranking System (HRS) survey was completed and the Site was assigned a ranking of 53.42. The Ciba-Geigy McIntosh Plant was included on the National Priorities List (NPL) in September 1983.

In October 1985, EPA issued Ciba-Geigy a RCRA permit, which included a Corrective action plan requiring Ciba-Geigy to remove and treat contaminated groundwater and surface water at the site. The corrective action plan stipulated that Ciba-Geigy would prepare a Remedial Investigation/ Feasibility Study (RI/FS) for the disposal areas being studied by the Superfund program. Figure 2 depicts the location of CERCLA areas within the Ciba-Geigy Site.

The ten units closed under the RCRA permit include:

- Diazinon Wastewater Sewer: Utilized to pipe Diazinon waste to the Diazinon Destruct Impoundment. Closure under post closure care in 1976.

- Triangular Impoundment: Constructed in the 1970s to decompose Diazinon residues. Closure during interim status completed in 1986.

- Rectangular Impoundment: Constructed in 1972-1973 to hold sludge from the dilute impoundment. Closure during interim status completed in 1987.

- Class C Landfill: Permitted by Alabama in 1973 and permitted under RCRA Interim Status regulations. Closure during interim status completed in 1987.

- Biological Sludge Landfill: Permitted by Alabama in 1978 and later operated under RCRA Interim Status for disposal of dewatered sludge. Closure during interim status completed in 1987.

- Diazinon Destruct Impoundment: Constructed in 1965. Closure under post closure care completed in 1989.

- GM-44 Impoundment: Put into service in early 1970s. Constructed for the GM-44 wastes high in nitrogen compounds. Its use was discontinued in the late 1970s. Closure under post closure care completed in 1989.

- Effluent Diffuser Line: Constructed in late 1968 to convey effluent for discharge into the Tombigbee River. Taken out of service in 1973 due to a change in the wastewater treatment system, closure of RCRA impoundments, and a change in the NPDES permit.

- Effluent Disposal Well: Installed in 1971. Used for the injection of biotreated effluent to reduce the quantity of NaC1 discharged into the river. The use of the well was unsuccessful and it was plugged in 1983. ADEM required no post-closure monitoring.

- Dilute Ditch: This ditch collected dilute wastewater and surface water runoff to be conveyed to the Dilute Impoundment. Use ceased in 1971. Continued monitoring of this ditch under a RCRA Corrective Action permit.

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Pursuant to the Corrective Action portion of the permit, in 1987, Ciba-Geigy installed a groundwater pumping system to intercept and remove contaminated groundwater from the shallow alluvial aquifer. The water removed from these wells was treated in the plant's existing on-site wastewater treatment system until fall 1988, when the plant's new biological wastewater treatment system was completed and used to treat the groundwater. The treated water is discharged into the Tombigbee River in compliance with appropriate National Pollutant Discharge Elimination System (NPDES) Regulations.

Ciba-Geigy has installed four (4) corrective action monitoring wells along the southern boundary of the property to monitor the effectiveness of the pumping well system. The effectiveness of the pump and treat system in preventing the migration of contaminated groundwater off-site and reducing the concentrations of contaminants in the groundwater is well established.

EPA completed the Superfund decision document (the Record of Decision or ROD) for operable unit one in September 1989 after public comments were carefully considered. The ROD identified the EPA selected remedy, "No Further Action". This selection was based on the established effectiveness of the groundwater pump and treat system already installed under the RCRA permit to address groundwater contamination in the shallow aquifer at the Site.

In accordance with the corrective action plan, Ciba-Geigy retained BCM, a technical consultant, to perform the RI/FS. Field work, which began in October 1985, was conducted by BCM on Ciba's behalf, with EPA's oversight. The principal finding of the RI study was the definition of the extent of contamination from eleven additional waste management areas within the study area that would be addressed under CERCLA.

The CERCLA Site has been grouped and divided into two Areas of Contamination (AOCs) based on their relative proximity to each other. The AOCs are roughly separated by the reservoir (See Figure 2).

In January 1990, Ciba-Geigy submitted the FS report. This report identified and screened alternatives for cleanup at the eleven former waste management areas. In September 1991, EPA issued a ROD addressing soil contamination at 10 of eleven 11 former waste management areas, (OU2), at the Site. In July 1992, EPA issued a ROD addressing soil contamination at the eleventh former waste management area (the bluffline Area 8).

The major components of the selected remedies for OU #2 and OU #4 as presented in November 1993 Explanation of Significant Differences and the Notice of Final Remedy Selection section of the December 1994 Fact Sheet include:

- Excavation of contaminated soils and sludges until established cleanup levels are reached or until site specific excavation limits are reached;

- On-site thermal treatment of approximately 240,000 cubic yards of highly contaminated soils and sludge;

- Treated soil and residual ash from the thermal treatment process which meet Land Disposal Restriction treatment standards are considered decontaminated and may be used as backfill for the excavated areas;

- In-situ soil flushing combined with isolation walls and extraction wells to remediate areas where the risk based cleanup levels are not achieved before, excavation depth of 20 feet is reached;

- Issuing a public notice in a local newspaper and sending a fact sheet to persons on the mailing list at the completion of the 30% design report. The purpose of the fact sheet and the public notice would be to inform the public of the technologies selected that were proven effective during the treatability studies conducted during the remedial design - addressed in the December 1994 Fact Sheet;

- Vegetating the area and establishing a suitable vegetative cover; and,

- Institutional controls for land use and groundwater use.

Ciba-Geigy signed an Administrative Order by Consent (AOC), effective March 31, 1992 with EPA to determine the potential ecological impact of contaminants in the floodplain, characterize any threat to Dublic health, welfare or the environment. Based on the data results from the Ecological Assessment/RI Report Addendum, DDE, DDT, DDD, atrazine, diazinon, simazine, butylbenzylphthalate and all herbicides were selected as Contaminants Of Potential Concern (COPCs) for evaluation of the floodplain risk assessment. In addition, Ciba-Geigy was required to develop and evaluate alternatives for remedial action.

EPA will continue its CERCLA enforcement activities and will notify Ciba-Geigy prior to the initiation of the remedial design for participation in the selected remedial action. Should Ciba-Geigy decline to conduct future remedial activities, EPA will either take additional CERCLA enforcement actions or provide funding for these activities while seeking cost recovery for all EPA-funded response actions at this Site.

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Figure 2-3 Site Map

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The RI for the Ciba-Geigy Site was released to the public in August 1988. The FS and the Proposed Plan for the Ciba-Geigy Site addressing Operable Unit 2, were released to the public on July 30, 1990. An addendum to the FS addressing the contamination in Area 8 (OU #4), and the Proposed Plan addressing OU #4 was released to the public in April 1992. The Remedial investigation Report Addendum / Ecological Assessment Report was released to the public in April 1994. The FS addendum and the Proposed Plan addressing contamination in the floodplain area (OU #3) was released to the public in December 1994. These documents were made available by placement in both the administrative record docket and the information repository maintained at the EPA docket room at Region IV Headquarters in Atlanta, Georgia and at the McIntosh Town Hall, in McIntosh, Alabama. Pursuant to regulations, a public comment period was held from December 15, 1994 through January 14, 1995.

A notice was placed in the Mobile Press Register on December 15, 1994 announcing the comment period. In addition to the public comment period and the administrative record files, a public meeting was held on December 20, 1994 in McIntosh Alabama. At this meeting representatives from EPA answered questions and addressed community concerns.

A response to all significant comments received during the public comment period is included in the Responsiveness Summary (Appendix A), which is a part of this Record of Decision.

This decision document presents the selected remedial action for operable unit three of the Ciba-Geigy Site, chosen in accordance with CERCLA, as amended by SARA and to the maximum extent practicable, the NCP. The decision for this Site is based on the administrative record. The requirements under Section 117 of CERCLA/SARA for public and state participation have been met for this operable unit.

4.0 SCOPE AND ROLE OF OPERABLE UNITS

Due to the size of the facility, the number of areas and the variety of contaminants, the problems at the Ciba-Geigy Site are complex. As a result EPA has organized the work into four (4) operable units (OUs). The operable units at this Site as identified in the ROD issued for Operable Unit Two in September 1991 are:

- OU #1 Contamination of the shallow (Alluvial) groundwater aquifer. The groundwater pump and treatment system is currently operating.

- OU #2 Contamination of soils at ten of eleven former waste management areas. The remedial design to implement this source control action is currently being prepared by Ciba-Geigy.

- OU #3 Contamination within the floodplain, the effluent ditch (previously called the lower portion of the dilute ditch) and areas in the Tombigbee River within close proximity to the Site.

- OU #4 Contamination of soils in former waste management Area 8 and the dilute ditch (previously called the upland portion of the dilute ditch). The remedial design to implement this source control action is currently being prepared by Ciba-Geigy.

This Operable Unit (OU #3), addresses the contamination within the floodplain area and the lower portion of the effluent ditch at the Site. The upper portion of the effluent ditch was closed in accordance with an approved RCRA Closure Plan. The ditch, as well as other closed units, was excavated, capped, and is being maintained through RCRA Post-Closure care. Upon further evaluation, EPA has decided to continue addressing the effluent ditch under RCRA authority, as administered through the HSWA Permit. In addition, the Tombigbee River close to the site will not be discussed in this operable unit because they are currently being addressed in the Mobile River Study.

The January 1990 Feasibility Study Report and the February 1992 addendum to the Feasibility Study Report submitted by Ciba-Geigy document the development, screening and detailed evaluation of potential alternatives for remediation of the former waste management areas identified and characterized during the Remedial Investigation. The July 1994 Feasibility Study Report Addendum documents the screening and evaluation of potential alternatives for remediation of the floodplain area. EPA has evaluated the alternatives considered for remediation of the floodplain area and the risk posed by the contaminants as they relate to the "CERCLA" Site. Based on this evaluation, EPA has determined which alternative or combination of alternatives would achieve the CERCLA cleanup objective, to remediate the source of the contamination, minimize the migration of the contamination from the soil/sediment to the groundwater/surface water, and prevent current or future exposure to contaminated groundwater or other environmental receptors. The approach to this operable unit is consistent with past work conducted at the Site.

5.0 SUMMARY OF SITE CHARACTERISTICS

The following sections describe the general characteristics at the site.

5.1 PHYSIOGRAPHY/GEOLOGY/CLIMATE

The Study Area is located in the Southern Pine Hills District of the East Gulf Coastal Plain

Physiographic Province and is situated in the bottomland floodplain adjacent to the Tombigbee River. The Southern Pine Hills is a moderately dissected plain that slopes gently to the south. In vicinity of the Site, the Tombigbee River is characterized by broad meanders and numerous oxbow lakes in a well developed floodplain. Elevations range to about 10 feet (MSL) and slopes range from zero to one percent in the Ciba-Geigy Corporation floodplain. This floodplain is separated from the adjacent upland terrace by a distinct escarpment having as much as 35 to 40 feet in relief and locally known as "the bluffline". The natural site topography has been locally modified with the development of floodplain roads and barrow, the construction of the effluent ditch, and the riverward extension of the bluffline.

The three prominent geologic structures in the region are the McIntosh Salt Dome, the Jackson Fault System, and the Mobile Graben. The Mobile Graben has been identified as a downthrown block fault paralleling the Tombigbee River. The Jackson Fault represents the easternmost upthrown fault boundary of the Mobile Graben. The westernmost upthrown fault boundary is not manifested as a surface displacement. The McIntosh Salt Dome is located approximately two miles southwest of the Study Area. The dome pierces the Miocene sediments within 440 feet of the ground surface and is approximately one mile in diameter. Southwestern Washington County is underlain by recent alluvium, Pleistocene age low terrace deposits, and sediments comprising the Miocene Series Undifferentiated. These strata consist of alternating deposits of sand, clay, silt, and gravelly sand.

Ciba-Geigy is situated upon a low terrace immediately adjacent to the Tombigbee River floodplain. A continuous surficial clay layer is underlain by deposits of silt, sand, gravel, and clay. The surficial clay layer ranges in thickness from only a few feet to over 50 feet. The contact with the underlying sand is characterized by sandy clay, sand and gravel. These Pleistocene deposits range in thickness from 60 to 100 feet. The Pleistocene deposits unconformably overlie more than 700 feet of alternating layers of Miocene age sand, gravels, and clays.

This region is characterized by the absence of exceptionally cold winters and the presence of high humidity. The relatively mild temperatures in south Alabama allow for a long growing season, ranging from approximately 230 days in southern Washington County to 300 days along the coast. Killing frost may not occur until early November in southern Washington County, and the last winter frost may be expected in mid-March.

Annual rainfall in south Alabama is among the highest in the contiguous United States, averaging about 64 inches. The precipitation is relatively evenly distributed over the year although there is a small peak in July during the thunderstorm season. July rainfall averages 7.6 inches. The driest season runs from October through November when the monthly average is 3.5 inches. Thunderstorms, the predominant mode of precipitation, occur on average 80 days a year, although more frequently in the summer than other seasons.

The McIntosh floodplain is a seasonally dynamic system influenced to a large extent by frequency and duration of inundation. Due to the seasonal variations in water depth and rainfall in the region, the entire floodplain is flooded for 3 to 5 months of the year (typically from December to April). In the vicinity of the Site, areas 25 feet in elevation and below are typically inundated with water during this period; these areas may be under 10 feet of water or more during part or all of the period of inundation.

Much of the floodplain is contiguous with the Tombigbee River during periods of complete inundation, and movements of fish and other aquatic organisms are largely unrestricted. From mid-to late spring, water begins to recede due to decreased flow rate in the Tombigbee River, decreased precipitation, and increased evaporation. The amount of available aquatic habitat shrinks as water collects in pools and depressions on the floodplain. Gradually throughout the summer months aquatic habitat becomes restricted to the areas of permanent water described above.

5.2 SOILS

The Ciba-Geigy Corporation floodplain is comprised of soils which include Urbo series in the upper half nearest the bluff line and the Ochlockonee series in the riverward half. The Urbo series consists of fine, mixed acid soils. The A horizons are predominantly silty clay loams with B horizons consisting of silty clay. These soils are formed an floodplain sediments throughout the Coastal Plain. Urbo series soils are somewhat poorly drained and are very slowly permeable. The Ochlockonee series consists of deep, well drained, loamy soils. These are formed in the alluvium of floodplains throughout the Coastal Plain. Within the study area these soils are restricted to those floodplain areas immediately adjacent to the Tombigbee River. Soil and sediment samples collected during this Ecological Assessment were subjected to sedimentary petrological analyses.

5.3 SURFACE WATER HYDROLOGY

The Tombigbee River flows in a southeasterly direction from its headwaters in northeastern Mississippi where it is linked to the Tennessee River, to its confluence with the Black Warrior River near Demopolis, Alabama, 267 miles downstream. From Demopolis, the Tombigbee flows south 175 miles where it converges with the Alabama River to form the Mobile River. The Mobile River flows south 45 miles to Mobile, entering into the Mobile Bay estuary. Significant portions of the Tombigbee River are flooded annually including the study area floodplain.

During low river stages, surface water features in the study area include Olin Basin and associated wetlands and depressions, and a portion of Johnson Creek which enters the floodplain on adjacent Boykin property north of the Ciba-Geigy Corporation property. Johnson Creek has been impounded and during low river stages forms a narrow pond (Boykin Pond) having a width of approximately 100 to 250 feet and a length of approximately 4500 feet.

5.4 BIOTA OBSERVATIONS

The flora and fauna in the vicinity of the Ciba-Geigy Corporation, McIntosh facility are typical of those found in the southern portions of the Alabama Coastal Plain. The Ciba-Geigy Corporation property exhibits floral species characteristic of bottomland floodplain forests as well as upland mixed hardwood-pine forests.

There are three vegetative communities within the floodplain: cypress-tupelo swamp, bottomland hardwood forest, and clearings. Cypress-tupelo forests occur in semi-permanently flooded areas that are flooded all of the dormant season (November through March) in most years. Trees in these areas are limited to those that can withstand extended periods of flooding. Tree species in these areas are dominated by bald cypress and water tupelo.
Bottomland hardwood forests occur in temporarily flooded areas which are generally flooded from December through March. The southern floodplain forests are dominated by various species of oak. The groundcover in mature bottomland hardwood stands is sparse because of the limited amount of light that penetrates the dense forest canopy. Also, in clearings and open areas on the floodplain herbaceous species are abundant.

The faunal assemblage found in the vicinity of the Site includes mammals such as opossums, moles, shrews, armadillos, rabbits, fox, raccoons, and white-tailed deer. Over 300 species of birds are found in the Lower Coastal Plain. Many species may be found in the vicinity of the Study Area. Representative amphibians and reptiles include frogs, toads, and salamanders, as well as the American alligator and numerous species of snakes.

Wetlands are typically highly productive and diverse systems that constitute habitat of high value to wildlife. They are important breeding grounds for migratory waterfowl and numerous other birds and also provide cover, forage, and resting and rearing habitat for birds, mammals, reptiles, and amphibians. In general, wetlands that contain a diversity of flora and provide several vegetative strata (e.g., shrub layer, herbaceous layer) have a greater habitat value because they provide more food, cover, and reproductive resources to a greater number of animals. Also, in general, larger wetlands that are continuous with other wetlands or habitat areas provide better habitat than smaller, isolated wetlands.

The wetlands in and around the Ciba-Geigy McIntosh floodplain are ranked as highly effective for promoting wildlife diversity and abundance by providing breeding, migration, and wintering habitat. The wetlands are used by migrating and resident waterfowl, wading birds, songbirds, raccoons, deer, and other species. It is important to keep in mind that the wetlands contained within the area represent only a fraction of the wetlands that occur in the local area and in the region.

The floodplain characteristics change seasonally, and with that, the amount of terrestrial habitat that is available also changes. In the winter and spring when the seasonal flooding occurs, the Site is used by a variety of wintering and migrating waterfowl, consisting mainly of the dabbling ducks such as mallard, pintail, blue-winged teal, and wood duck (Aix sponsa). The Site is used as breeding habitat by some birds although the highest concentrations of breeding birds are found further south in the river delta. More terrestrial-based wildlife (e.g., many mammals) likely are concentrated in the upland portions of adjacent lands. During summer and fall when waters recede, waterfowl usage decreases and wading bird species use increases. Great blue heron, green-backed heron, little blue heron, great egret, and snowy egret have been observed feeding in pools and swamp on-site. More terrestrial wildlife species also likely increase the use of the floodplain at this time.

Mammals known to occur at the site include raccoon, opossum, cottontail, muskrat, armadillo, and white-tailed deer. Other species likely to occur are swamp rabbit, river otter, and mink. Based on the results-of field surveys both on the Ciba-Geigy property and at the nearby Fred T. Stimpson Wildlife Sanctuary, small mammals (e.g., rodents, shrews) do not appear to be abundant on the floodplain of the Tombigbee River. This is likely, related to the limited herbaceous layer that is characteristic of swamps and bottomland hardwood forests, since small mammals rely on the herbaceous layer to provide forage and cover from predators. An additional factor which may influence the abundance of small mammals on floodplains is that, due to their smaller home range, much of the floodplain is too distant from the habitat they use when the floodplain is inundated.

The only rare, threatened, or endangered species known to occur on the McIntosh site is the American alligator (Alligator mississippiensis), which is classified as "threatened due to similarity of appearance (T/SA)". This classification is assigned to the alligator because of its similarity to the American crocodile (Crocodylus acutus), which is a Federal endangered species. Populations of the American alligator are not considered ecologically threatened at this time. Because of the T/SA status, State authorities closely regulate the harvesting of alligators by issuing a limited number of hunting permits and by tracking the skins of the harvested animals to ensure that the skins are not those of the endangered crocodile.

6.0 SUMMARY OF SITE RISK

CERCLA directs the Agency to conduct a baseline risk assessment to determine whether a Superfund Site poses a current or potential threat to human health and the environment in the absence of any remedial action. The baseline risk assessment provides the basis for determining whether or not remedial action is necessary and the justification for performing remedial action.

6.1 CONTAMINANTS OF CONCERN

Soil/Sediment

Soil and sediment samples were collected in May and June 1992 along Transects A through E and a background area. Six samples were collected from Transects A, B and C for a total of 18 samples. Three samples were collected from Transects D and E for a total of six samples (see Figure 6-1). Fourteen additional samples (F1 through F14) were collected throughout the floodplain in areas between the transects. The F-series samples were analyzed only for DDD, DDE and DDT Six soil/sediment samples were collected from the background area. Eighteen additional samples containing DDTR were collected by Woodward Clyde in the Olin Basin under another CERCLA investigation. Tables 6-1 and 6-2 present a summary of chemicals detected in surficial soil and sediment in the Ciba-Geigy floodplain and a summary of chemicals detected in the sediment of the Olin Basin respectively. The summary tables present the frequency of detection, the mean, the number of samples used to calculate the mean, the range of detection limits, and the range of detection limits.

Floodplain

DDE, DDT and DDD were the most frequently detected organic chemicals and were present in greater than 60% of all soil/sediment samples collected from the floodplain. Concentrations were greatest in samples collected from or near drainage ways and from areas closest to the bluffline. Concentrations throughout the remainder of the floodplain were lower and generally less than 100 ug/kg. The highest concentration of DDT (152 mg/kg), was detected at sample location C1.

Although fewer data are available, the distribution of other frequently detected organic chemicals within the floodplain appear to follow somewhat a similar pattern. For example, the highest concentrations of 5 of the remaining 10 insecticides (alpha-, beta-, and delta-BHC, chlorobenzilate, and hexachlorobenzene) were found near the drainage ways or close to the bluffline. Most of the other highest concentrations of contaminants (including herbicides) were detected in other portions of the D-transect drainage way or near the bluffline.

Olin Basin

DDE, DDD, and DDT were the most frequently detected organic chemicals in the Olin Basin (19 out of 19 samples). The concentrations of these chemicals, however, were substantially below those detected in the floodplain.

Chlorobenzene, which was not detected in the floodplain, also was detected in all Olin Basin samples. Hexachlorobenzene (8/19) was the most frequently detected of the remaining organic chemicals at a concentration significantly greater than the single floodplain sample in which it was detected.

In contrast to the floodplain, several inorganic chemicals were detected in the Olin Basin at concentrations significantly (statistically) above background. Antimony, copper, cyanide, mercury sodium and zinc were the inorganic chemicals detected above background.

Surface Water

A total of 18 surface samples were collected in May and June 1992. Three samples each were collected from Transects A, B, C, D, E and from the background Area. Table 6-3 contains the summarized surface water data. Table 6-4 identifies chemicals of potential concern for surface soil/sediment, surface water and biota.

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Table 6-1

SUMMARY OF CHEMICALS DETECTED IN SURFICIAL SOIL AND SEDIMENT FLOODPLAIN ECOLOGICAL ASSESSMENT

(Concentrations reported in ug/kg for organics, mg/kg for inorganics)

	Chemical (a)	Frequency of Detection (b)	Mean Sample Size (c)	Mean Concentration (d)	Range of Detection Limits (d,e)	Range of Detected Concentrations (d) On-site	Range of Detected Concentrations (d) Background (e,f)
	Herbicides:						
+	Ametryn (g)	12 / 23	23	152	7.4 - 28	9.25 - 2,200	ND (7.6 - 15)
*+	Alrazine	7 / 23	23	1,880	5.3 - 21	6 - 35,000	ND (5.6 - 11)
+	Prometon(g)	3 / 23	23	18.3	12.8 - 55	46 - 110	ND (15 - 30)
+	Prometryn (g)	8 / 23	23	43.7	6.2 - 24.5	11.5 - 510	ND (6.6 - 13)
+	Propezine (g)	5 / 23	23	563	4.6 - 18	5.75 - 8,300	ND (4.8 - 9.7)
*+	Simazine)	5 / 23	23	1,500	11.6 - 46	14 - 32,000	ND (12 - 25)
+	Simetryn (g)	8 / 23	23	22.2	17.1 - 65	21 - 90	ND (17 - 35)
+	Terbuthylazine (g)	3 / 23	23	72.2	4.9 - 19.5	33 - 1,500	ND (5.2 - 11)
+	Terbulryn (g)	6 / 23	23	38.2	11.8 - 46.5	26 - 360	ND (12 - 25)
+	Tolban (g)	3 / 23	16	17.7	12.7 - 44.1	10 - 100	ND (13 - 30)
	Insecticides:						
	alpha-BHC (g)	3 / 23	23	42.6	2.21 - 240	2.75 - 530	ND (2.3 - 5.1)
	beta-BHC (g)	2 / 23	23	40.4	2.21 - 240	6 - 610	ND (2.3 - 5.1)
	delta-BHC (h)	1 / 23	23	35	2.21 - 240	490	ND (2.3 - 5.1)
	Chlorobenzilate (g)	6 / 23	23	463	21 - 2220	19 - 6,500	ND (21 - 49)
*	ODD	22 / 37	37	3,730	4.20 - 29.8	18.2 - 67,000	ND (40.4 - 93.9)
*	DDE	25 / 37	37	3,820	4.39 - 53.2	25.3 - 51,000	ND (25.4 - 56.9)
*	DDT	24 / 37	37	3,000	4,39 - 29.8	15.5 - 57,000	ND (25.4 - 56.9)
*	Diazinon	2 / 23	23	16.2	16 - 70	28 - 76	ND (19 - 38)
	Heplachlor Epoxide (h)	1 / 21	21	11.5	2,21 - 108	89	ND (2.3 - 5.1)
	Hexachlorobonzene (h)	1 / 23	2	197	389	200	ND (409 - 1,200)
	Other Organic Chemicals:						
	Benzo(b)fluoranthene (h)	1 / 23	1	NC	NA	83	ND (409 - 1,200)
*	Butytbenzylphlhalate	11 / 23	23	398	419 - 1,600	13 - 1,400	ND (409 - 1,200)
	Chlorobenzene (g)	2 / 23	2	3.5	NA	3 - 4	ND (13 - 1,500)
	Chloroform (g)	6 / 23	23	15.3	12 - 56	0.5 - 160	0.8 - 0.2
	Chrysene (h)	1 / 23	1	NC	NA	42	ND (409 - 1,200)
	Dibenzofuran (h)	1 / 23	1	NC	NA	110	ND (409 - 1,200)
	Di-n-butylphthalate (g)	14 / 23	23	1,690	420 - 1,600	920 - 5,200	ND (410 - 1,500)
	Fluoranthene (g)	4 / 23	4	67.5	NA	22 - 170	140
	2-Nitroaniline (h)	1 / 23	23	770	944 - 3,880	2,200	ND (992 - 2,910)

See footnotes at end of table.

Table 6-1 (Cont.)

SUMMARY OF CHEMICALS DETECTED IN SURFICIAL SOIL AND SEDIMENT FLOODPLAIN ECOLOGICAL ASSESSMENT

(Concentrations reported in ug/kg for organics, mg/kg for inorganics)

Chemical (a)	Frequency of Detection (b)	Mean Sample Size (c)	Mean Concentration (d)	Range of Detection Limits (d,e)	Range of Detected Concentrations (d) On-site	Range of Detected Concentrations (d) Background (e,f)
ORGANICS (cont.):						
Other Organics Chemicals:						
Nitrobenzene (h)	1 / 23	1	NC	NA	130	ND (409 - 1,200)
Phenanthrene (g)	2 / 23	2	88	NA	26 - 150	ND (409 - 1,200)
Pyrene (g)	3 / 23	3	59.3	NA	22 - 130	110
Toluene (g)	5 / 23	22	8.48	12 - 50	2 - 25.5	ND (13 - 1,500)
INORGANICS:						
Aluminum (i)	23 / 23	23	22,700	NA	3,130 - 50,300	3,060 - 28,600
Arsenic (i)	20 / 23	23	5.18	0.24 - 0.41	0.6 - 41.8	0.4 - 6.1
Barium (i)	23 / 23	23	125	NA	31.1 - 235	19.3 - 156
Beryllium (i)	22 / 23	23	1.24	0.21	0.25 - 3.2	1.2 - 1.9
Calcium (i)	23 / 23	23	10,900	NA	319 - 148,000	263 - 4,120
Chromium (i)	23 / 23	23	39.2	NA	9.6 - 70.5	3.5 - 48.5
Cobalt (i)	23 / 23	23	13.7	NA	2.1 - 68.2	1.9 - 14.3
Copper (i)	23 / 23	23	21.2	NA	2.4 - 75.8	2.1 - 13.3
Cyanide (i)	5 / 23	23	0.079	0.06 - 0.25	0.12 - 0.37	0.1 - 0.3
Iron (i)	23 / 23	23	33,330	NA	4,700 - 85,800	1,230 - 32,900
Lead (i)	23 / 23	23	22.3	NA	2.1 - 48.6	4 - 39.1
Magnesium (i)	23 / 23	23	1840	NA	233 - 3,990	279 - 3,050
Manganese (i)	23 / 23	23	448	NA	17.9 - 1,770	18.1 - 1,110
Mercury (i)	23 / 23	23	4.48	NA	0.01 - 95.8	0.02 - 0.11
Nickel (i)	22 / 23	23	16.7	3.52	3.4 - 35.4	4 - 23.6
Potassium (i)	21 / 23	23	1370	153 - 209	295 - 3,250	830 - 2,040
Selenium (i)	2 / 23	22	0.357	0.45 - 1.21	0.58 - 0.64	ND (0.49 - 0.97)
Silver (i)	8 / 23	22	1.42	1.28 - 3.62	1.72 - 2.8	ND (1.5 - 3.0)
Sodium (i)	18 / 23	23	289	136 - 213	56.1 - 1,560	84.9 - 247
Vanadium (i)	23 / 23	23	54.3	NA	15.1 - 107	4.4 - 59.7
Zinc (i)	23 / 23	23	90.8	NA	17.5 - 358	13.3 - 93.6

See footnotes at end of table.

Table 6-1 (Cont.)

SUMMARY OF CHEMICALS DETECTED IN SURFICIAL SOIL AND SEDIMENT: FLOODPLAIN ECOLOGICAL ASSESSMENT

(Concentrations reported in ug/kg for organics, mg/kg for inorganics)

*	= Chemical of potential concern. See text for e description of procedures used to select chemicals of potential concern.
*	= Chemical of potential concern for plants. See text.
NA	= Not applicable; chemical detected in every sample or non-detected samples had high detection limits such that one-half of the detection limit exceeded the maximum detected value. (These values were excluded from the data end summary. See text.)
ND	= Not detected. (Detection limits in parentheses.)
NC	= Not calculated; only one sample available for mean calculation.

(a) Values presented for DDT and matebolites are the sum of values for the o,p'- and p,p'-isomers.
(b) The number of samples in which the chemical was detected divided by the total number of samples analyzed.
(c) The number of samples used to calculate the mean. This number may differ from the denominator of the frequency of detection because non-dated samples with high detection limits were not included in the calculation of the mean.
(d) Values rounded to no more than three significant figures.
(e) Detection limits are only those for which one-half of the detection limit was less than the maximum detected value. See text
(f) Background concentrations reported are for soil and sediment collected from the Stimpson Wildlife Sanctuary, located up-river from the CIBA-GEIGY McIntosh plant.
(g) Eliminated as a chemical of potential concern based on concentration-toxicity screening. See text and Appendix B.
(h) Eliminated as a chemical of potential concern because chemical was detected in 5% or less of samples.
Eliminated as a chemical of potential concern because concentrations were not statistically higher than background.

Table 6-2

SUMMARY OF CHEMICALS DETECTED IN SEDIMENT: OLIN BASIN
ECOLOGICAL ASSESSMENT

(Concentrations reported In ug/kg for organics, mg/kg for Inorganics)

	Chemical (a)	Frequency of Detection (b)	Mean Sample Size (c)	Mean Concentration (d)	Range of Detection Limits (d,e)	Range of Detected Concentrations (d) On-site	Range of Detected Concentrations (d) Background (e,f)
	ORGANICS:						
	Insecticides:						
	Aldrin (g)	1 / 19	18	5.32	3.5 - 35	30	ND (2.3 - 5.1)
	alpha-BHC (h)	2 / 19	17	4.75	23 - 24	10	ND (2,3 - 5.1)
	beta BHG (h)	3 / 19	18	6.06	2.3 - 35	10 - 20	ND (2.3 - 5.1)
	delta-BHC(h)	2 / 19	19	27.2	23 - 130	50 - 170	ND (2.3 - 5.1)
	gamma-BHC (g)	1 / 18	18	5.36	3.5 - 35	30	ND (2.3 - 5.1)
	DDD (h)	19 / 19	19	573	NA	73 - 1800	ND (40.4 - 93.9)
	DDE (h)	19 / 19	19	608	NA	70 - 1400	ND (25.4 - 56.9)
	DDT (h)	19 / 19	19	476	NA	34 - 4000	ND (25.4 - 56.9)
	Endosulfan I (g)	1 / 18	18	36.2	3.5 - 220	110	ND (2.3 - 5.1)
	Endosullan II (g)	1 / 18	18	10.3	6.9 - 67	50	ND (4.4 - 9.4)
	Heptachlor Epoxide (g)	1 / 19	17	3.87	3 - 9.2	20	ND (2.3 - 5.1)
	Hexachlorobenzene (h)	8 / 19	19	5,370	670 - 1,700	500 - 40000	ND (409 - 1,200)
	Other Organic Chemicals:						
	Chlorobenzene (h)	19 / 19	19	161	NA	10 - 1000	ND (21 - 49)
	1,3-Dichlorobenzene (h)	4 / 19	9	345	670 - 980	40 - 590	ND (409 - 1,200)
	1,4-Dlchlorobenzene (h)	4 / 18	9	394	670 - 980	190 - 510	ND (4.09 - 1201)
	INORGANICS:						
	Aluminum (i)	1 / 1	1	NC	NA	12100	3,060 - 28,600
*	Antimony	4 / 6	6	14.9	6.20 - 11.9	10.1 - 24.6	ND (4.21 - 8.51)
	Arsenic (i)	19 / 19	19	7.1	NA	2.1 - 16.1	0.4 - 6.1
	Barium (i)	1 / 1	1	NC	NA	55.7	19.3 - 156
	Beryllium (i)	2 / 19	19	1.05	0.23 - 2.70	0.9 - 3.7	1.2 - 1.9
	Calcium (i)	1 / 1	1	NC	NA	1660	263 - 4,120
	Chromium (i)	19 / 19	19	328	NA	6.1 - 52.1	3.5 - 48.5
	Cobalt (i)	1 / 1	1	NC	NA	10.4	1.9 - 14.3
*	Copper	18 / 19	19	255	3.30	12.5 - 57.5	2.1 - 13.3
*	Cyanide	5 / 19	19	0.575	0.09 - 1.20	0.78 - 1.5	0.1 - 0.3
	Iron (i)	1 / 1	1	NC	NA	20500	1,230 - 32,900
	Lead (i)	19 / 19	19	22.9	NA	5.9 - 44.2	4 - 39.1
	Magnesium (i)	1 / 1	1	NC	NA	1090	279 - 3,050
	Manganese (i)	1 / 1	1	NC	NA	290	18.1 - 1,110

See footnotes at end of table.

Table 6-2 (Cont.)

SUMMARY OF CHEMICALS DETECTED IN SEDIMENT: OLIN BASIN
ECOLOGICAL ASSESSMENT

(Concentrations reported In ug/kg for organics, mg/kg for Inorganics)

	Chemical (a)	Frequency of Detection (b)	Mean Sample Size (c)	Mean Concentration (d)	Range of Detection Limits (d,e)	Range of Detected Concentrations (d) On-site	Range of Detected Concentrations (d) Background (e,f)
*	Mercury	19 / 19	19	43.8	NA	3 - 290	0.02 - 0.11
	Nickel (i)	1 / 19	14	8.43	2.50 - 27.90	10.9	4 - 23.6
	Potassium (i)	1 / 19	1	NC	NA	1170	830 - 2.040
*	Sodium	1 / 1	1	NC	NA	1030	84.9 - 247
	Vanadium (i)	1 / 1	1	NC	NA	32.9	4.4 - 59.7
*	Zinc	19 / 19	19	132	NA	8 - 227	13.3 - 93.6

* = Chemical at potential concern. See text for a description of procedures used to select chemicals at potential concern.
NA = Not applicable; chemical detected in every sample or non-detected samples had high detection limits such that one-half of the detection limit exceeded the maximum detected value. (These values were excluded from the data and summary. See text.)
ND = Not detected (Detection limits in parentheses.)
NC = Not calculated; only one sample available for mean calculation.

(a) Values presented for DDT and metabolites are the sum of values for the o,p'- and p,p'-Isomers.
(b) The number of samples in which the chemical was detected divided by the total number of samples analyzed.
(c) The number of samples used to calculale the mean. This number may differ from the denominator of the frequency of detection because non-detect samples with high detection limits were not included in the calculation of the mean.
(d) Values rounded to no more than three significant figures.
(e) Detection limits are only those for which one-half of the detection limit was less than the maximum detected value. See text.
(f) Background concentrations reported are for soil and sediment collected from the Stimpson Wildlife Sanctuary, located up-river from the CIBA-GEIGY McIntosh plant.
(g) Eliminated as a chemical of potential concern because chemical was detected in approximately 5% or less of samples.
(h) Eliminated as a chemical of potential concern based on concentration-toxicity screening. See text and Appendix B.
(i) Eliminated as a chemical of potential concern because concentrations were not statistically higher than background; or, if a statistical evaluation were not possible, the detected concentration was below the mean concentration reported for the CIBA-GEIGY floodplain.

Herbicides were the most frequently detected organic chemicals, and were present in over 70% of the floodplain samples at concentrations between 0.02 and 390 ug/L. Ametryn, atrazine, prometryn, and simazine were detected in 50% to 71% of all samples, whereas the remaining herbicides were detected in 35% or less of all samples. Highest surface concentrations of many of these chemicals were detected at location A3, which is a shallow groundwater sample that was collected because no surface water was available at this location.

DDTR was detected in 42% or less of the samples. Highest surface water concentrations of DDD and DDE were detected at D1, located in the cypress swamp adjacent to the Ciba-Geigy property at the same location as the highest detected sediment concentration for these two chemicals. DDT, however, was not detected in the surface water at this location although it was present in the sediment. A3 was the only sample location in which DDT was present in the surface water (shallow groundwater sample).

Chromium, cobalt, copper, cyanide, and nickel were present in floodplain surface water samples above background concentrations. The maximum detected concentration for each of these chemicals occurred in the shallow ground water sample collected at A3.

Table 6-4 presents a summary of the chemicals selected for evaluation in the ecological assessment. The primary chemicals of potential concern are DDT and its metabolites DDE and DDD collectively referred to as DDTR. These chemicals were detected at relatively high frequencies in soil/sediment and biota. In addition, DDTR is a foodchain accumulating ecologically toxic contaminant. Concentrations of DDT-related compounds and other chemicals were generally highest in the former effluent ditch, in the drainage way that flows west from the floodplain, or near the bluffline. Additional chemicals of concern are ametryn, atrazine, butylbenzylphthalate, prometon, prometryn, propazine, simetryn, terbuthylazine, terbutryn, tolban, chromium, copper, cyanide, nickel, and mercury.

All of the herbicides detected in surface water and soil/sediment were included as chemicals of potential concern for plants in these media because of their known toxicity to at least some plant species. With the exception of atrazine and simazine in soil/sediment, the herbicides were not selected as chemicals of potential concern for other potential ecological receptors based on a comparison of toxicity concentrations found in background ecological receptors. Although there were fewer soil samples analyzed for these chemicals than for DDTS. there is still a general trend of higher concentrations in the drainage ways or areas of lower elevation and near the bluffline.

Butylbenzylphthalate was included as a COPC for soil/sediment although it was detected in concentrations bordering on the detection limit and could potentially be a laboratory artifact.

Table 6-3

SUMMARY OF CHEMICALS DETECTED IN FLOODPLAIN STUDY AREA SURFACE WATER (a)

HUMAN HEALTH ASSESSMENT
(Concentrations reported in ug/L)

	Chemical	Frequency of Detection (c)	Mean Sample Size (d)	Mean Concentration (e)	Range of Detection Limits (e,i)	Ranqe of Detected Concentrations (e) Study Area	Background (f)
	ORGANICS:						
*	Ametryn	10 / 14	14	3.42	0.6 - 1.2	0.1 - 39	ND (0.06)
*	Atrazine	8 / 14	14	34.3	0.1	0.1 - 260	ND (0.08)
*	alpha-BHC	5 / 14	14	0.538	0.1	0.1 - 2.9	ND (0.05)
*	beta-BHC	5 / 14	14	0.150	0.1	0.1 - 0.62	ND (0.05)
	delta-BHC (j)	1 / 14	12	0.040	0.05 - 0.2	0.1	ND (0.05)
	Chlorobenzilate (h)	2 / 14	11	0.077	0.1 - 0.22	0.1 - 0.18	ND (0.11)
	Chloroform (h)	2 / 14	14	6.14	10	12 - 14	ND (10)
	Chloropropylale (h)	1 / 14	11	0.0677	0.1 - 0.2	0.14	ND (0.11)
*	DDD (b)	6 / 14	14	0.644	0.05 - 0.8	0.1 - 3.13	ND (0,14)
*	DDE (b)	2 / 14	14	0.333	0.04 - 0.8	1.0 - 1.59	ND (0.15)
*	DDT (b)	1 / 14	14	0.225	0.1 - 0.8	1.7	ND (0.16)
	Endosulfan I (h)	1 / 14	11	0.0338	0.05 - 0.1	0.1	ND (0.05)
	Metolachlor (h)	1 / 14	13	0.291	0.5	0.9	ND (0.48)
	Prometon (h)	3 / 14	14	0.46	0.1	0.32 - 3.2	ND (0.13)
*	Prometryn	9 / 14	14	2.64	0.1	0.2 - 16	ND (0.08)
*	Propazine	5 / 14	14	30.7	0.1	0.2 - 390	ND (0.07)
*	Simazine	7 / 14	14	10.1	0.1	0.2 - 81	ND (0.14)
	Simetryn (j)	3 / 14	14	0.35	0.1 - 2.8	0.2 - 2.2	ND (0.14)
*	Terbuthylazine	3 / 14	14	1.6	0.1	0.5 - 19	ND (0.06)
*	Terbutryn	5 / 14	14	1.0	0.1	0.1 - 13	ND (0.12)
	Tolban (h)	1 / 14	11	0.0118	0.02 - 0.04	0.02	ND (0.02)
	Trichloroethene (h)	1 / 14	1	NC	NA	0.5	ND (10)
	INORGANICS:						
	Aluminum (g)	9 / 14	14	1,940	273 - 345	517 - 8,080	504 - 1,560
	Barium (g)	14 / 14	14	92.1	NA	23 - 410	19.4 - 56.5
	Beryllium (g)	1 / 14	14	0.564	1	1.4	ND (1.0)
	Calcium (g)	14 / 14	14	27,000	NA	1,850 - 103,000	3,620 - 27,900
	Chromium (h)	4 / 14	14	4.68	5	5.1 - 13.6	ND (5.0)
	Cobalt (j)	4 / 14	14	7.61	5	8.1 - 31	ND (5.0)
	Copper (h)	6 / 14	14	7.76	4	4.2 - 58.6	ND (4.0)

See footnotes on following page.

Table 6-3 (Cont.)

SUMMARY OF CHEMICALS DETECTED IN FLOODPLAIN STUDY AREA SURFACE WATER (a)

HUMAN HEALTH ASSESSMENT

(Concentrations reported in ug/L)

	Chemical	Frequency of Detection (c)	Mean Sample Size (d)	Mean Concentration (e)	Range of Detection Limits (e,i)	Ranqe of Detected Concentrations (e) Study Area	Background (f)
	ORGANICS:						
*	Ametryn	10 / 14	14	3.42	0.6 - 1.2	0.1 - 39	ND (0.06)
*	Atrazine	8 / 14	14	34.3	0.1	0.1 - 260	ND (0.08)
*	alpha-BHC	5 / 14	14	0.538	0.1	0.1 - 2.9	ND (0.05)
*	beta-BHC	5 / 14	14	0.150	0.1	0.1 - 0.62	ND (0.05)
	delta-BHC (j)	1 / 14	12	0.040	0.05 - 0.2	0.1	ND (0.05)
	Chlorobenzilate (h)	2 / 14	11	0.077	0.1 - 0.22	0.1 - 0.18	ND (0.11)
	Chloroform (h)	2 / 14	14	6.14	10	12 - 14	ND (10)
	Chloropropylale (h)	1 / 14	11	0.0677	0.1 - 0.2	0.14	ND (0.11)
*	DDD (b)	6 / 14	14	0.644	0.05 - 0.8	0.1 - 3.13	ND (0,14)
*	DDE (b)	2 / 14	14	0.333	0.04 - 0.8	1.0 - 1.59	ND (0.15)
*	DDT (b)	1 / 14	14	0.225	0.1 - 0.8	1.7	ND (0.16)
	Endosulfan I (h)	1 / 14	11	0.0338	0.05 - 0.1	0.1	ND (0.05)
	Metolachlor (h)	1 / 14	13	0.291	0.5	0.9	ND (0.48)
	Prometon (h)	3 / 14	14	0.46	0.1	0.32 - 3.2	ND (0.13)
*	Prometryn	9 / 14	14	2.64	0.1	0.2 - 16	ND (0.08)
*	Propazine	5 / 14	14	30.7	0.1	0.2 - 390	ND (0.07)
*	Simazine	7 / 14	14	10.1	0.1	0.2 - 81	ND (0.14)
	Simetryn (j)	3 / 14	14	0.35	0.1 - 2.8	0.2 - 2.2	ND (0.14)
*	Terbuthylazine	3 / 14	14	1.6	0.1	0.5 - 19	ND (0.06)
*	Terbutryn	5 / 14	14	1.0	0.1	0.1 - 13	ND (0.12)
	Tolban (h)	1 / 14	11	0.0118	0.02 - 0.04	0.02	ND (0.02)
	Trichloroethene (h)	1 / 14	1	NC	NA	0.5	ND (10)
	INORGANICS:						
	Aluminum (g)	9 / 14	14	1,940	273 - 345	517 - 8,080	504 - 1,560
	Barium (g)	14 / 14	14	92.1	NA	23 - 410	19.4 - 56.5
	Beryllium (g)	1 / 14	14	0.564	1	1.4	ND (1.0)
	Calcium (g)	14 / 14	14	27,000	NA	1,850 - 103,000	3,620 - 27,900
	Chromium (h)	4 / 14	14	4.68	5	5.1 - 13.6	ND (5.0)
	Cobalt (j)	4 / 14	14	7.61	5	8.1 - 31	ND (5.0)
	Copper (h)	6 / 14	14	7.76	4	4.2 - 58.6	ND (4.0)

See footnotes on following page.

TABLE 6-4 SUMMARY OF CHEMICALS OF POTENTIAL CONCERN

CHEMICAL	SURFACE SOIL/SEDIMENT	SURFACE WATER	BIOTA
Ametryn	(P)	(P)	
Atrazine	X(P)	X(P)	
Butylbenzylphthalate	X		
DDD	X	X	X
DDE	X	X	X
DDT	X	X	X
Prometon	(P)	(P)	
Prometryn	(P)	(P)	
Propazine	(P)	(P)	
Simazine	X(P)	(P)	
Simetryn	(P)	(P)	
Terbuthylazine	(P)	(P)	
Terbutryn	(P)	(P)	
Tolban	(P)		
INORGANICS:			
Chromium		X	X(raccoon only)
Copper		X	
Cyanide		X	
Mercury	X		X
Nickel		X	

X = selected as a chemical of potential concern.
(P) = selected as a chemical of potential concern for plants.

6.2 HUMAN HEALTH RISK

Potential exposure pathways were reviewed and selected for quantitative evaluation in the risk assessment. Because of the drastic annual flooding conditions which limit development and exposure, current and future land-use conditions were considered to be similar. Exposure pathways selected for detailed evaluation are:

- direct contact with contaminated sediments or dust particles,
- ingestion of venison,
- ingestion of animals or fish contaminated by animals (including venison) feeding in the impacted area,
- dermal skin) absorption of chemicals in surface soil/sediment or surface water by a worker or trespasser.

The chemicals present most frequently and at the highest concentrations in soil/sediment were DDT and its metabolites DDD and DDE. In floodplain surface water, the more soluble triazine herbicides were most frequently detected and were measured at the highest concentrations. DDTR and hexachlorobenzene in fish tissue and DDTR in crayfish were of most concern for the risk assessment.

EPA's target risk range for Superfund cleanups is 1 x 10-4 to 1 x 10-6 A 1 x 10-4 range is equivalent to an increased chance of one additional case of cancer in 10,000 individuals as a result of this level of exposure to the contaminants at the site. A 1 x 10-6 range is equivalent to an increased chance of one additional case of cancer in 1,000,000 individuals as a result of this level of exposure to the contaminants at the site. Also, the concentrations of non-carcinogenic chemicals must have hazard indices less than 1.0. All of the upperbound excess lifetime cancer risks were already either lower than USEPAs benchmark of 1x10-6, or were within the acceptable risk range of 1x10-4 to 1x10-6 as long as groundwater is not used for drinking or bathing. All hazard indices were less than 1.0 which indicates that adverse noncarcinogenic effects are unlikely to occur.

Table 6 5 provides a summary of RME risk estimates cancer risk due to all chemicals for human health assessments using current land-use conditions. Table 6-6 provides a summary of RME risk estimates noncancer risk due to all chemicals for human health assessments using current land-use conditions.

6.3 ECOLOGICAL RISK

Potential risk to ecological receptors was characterized using both quantitative and qualitative methods. Quantitative risk estimates, derived by comparing estimates of exposure in selected receptors to no-effect levels, were used to evaluate drinking water and dietary exposure in birds and mammals. Qualitative evaluations were made for all receptors based on bioassay results, tissue residues, and published toxicity data.

Table 6-5

SUMMARY OF RME RISK ESTIMATES
CANCER RISK DUE TO ALL CHEMICALS

HUMAN HEALTH ASSESSMENTS
CURRENT LAND-USE CONDITIONS

	Floodplain Trespassers	Olin Basin Trespassers	Adult Workers	Hunters	Anglers	Floodplain Crayfish Consumers
Incidental Ingestion of Surface Soil/Sediment (a)	1E-7		4E-7			
Incidental Ingestion of Olin Basin Sediment		1E-7				
Dermal Contact with Surface Soil/Sediment (a)	5E-8		2E-7			
Dermal Contact with Olin Basin Sediment		5E-8				
Dermal Contact with Surface Water (b)	7E-8		8E-7			
Ingestion of Venison				2E-8		
Ingestion of Olin Basin Fish					4E-5 (c)	
Ingestion of Crayfish						9E-6

See footnotes on following page.

Table 6-5

SUMMARY OF RME RISK ESTIMATES
NONCANCER RISK DUE TO ALL CHEMICALS

HUMAN HEALTH ASSESSMENTS
CURRENT LAND-USE CONDITIONS

	Floodplain Trespassers	Olin Basin Trespassers	Adult Workers	Hunters	Anglers	Floodplain Crayfish Consumers
Incidental Ingestion of Surface Soil/Sediment (a)	<1 (7E-4)		<1 (4E-3)			
Incidental Ingestion of Olin Basin Sediment		<1 (6E-3)				
Dermal Contact with Surface Soil/Sediment (a)	<1 (3E-4)		<1 (2E-3)			
Dermal Contact with Olin Basin Sediment		<1 (3E-3)				
Dermal Contact with Surface Water (b)	<1 (4E-4)		<1 (1E-2)			
Dermal Contact with Olin Basin Surface Water		<1 (5E-6)				
Ingestion of Venison				< 1 (1E-4)		
Ingestion of Olin Basin Fish					<1 (4E-1)	
Ingestion of Crayfish						<1 (2E-2)

(a) Direct contact exposures to soil/sediment by trespassers have been evaluated using floodplain study area surface soil/sediment while exposures to workers have been evaluated using floodplain surface soil/sediment within property boundaries.
(b) Dermal absorption of surface water by trespassers has been evaluated using floodplain study area surface water, while exposure to surface water by workers has been evaluated using floodplain surface water within property boundaries.
(c) Risk associated with the 90th and 95th percentile of exposure to DDTR as determined by a Monte Carlo analysis was 1 E-05. The typical risk or mode of the distribution as specified by USEPA 1992a was 3E-06.

Table 6-7

SUMMARY OF RME RISK ESTIMATES

HUMAN HEALTH ASSESSMENT
FUTURE LAND-USE CONDITIONS

	Cancer Risk Due to All Chemicals		Noncancer Risk Due to All Chemicals	
	Adult Trespassers	Angelers	Adult Trespassers	Angelers
Incidental Ingestion of Olin Basin Sediment	2E-7		<1(8E-3)	
Dermal Contact with Olin Basin Sediment	7E-8		<1(5E-3)	
Dermal Contact with Olin Basin Surface Water			<1(7E-6)	
Ingestion of Olin Basin Fish		6E-5		<1(5E-1)

6.3.1 Sampling Methodology

Plants (Saururus cernuus)

Representative samples of the nodding lizard's tail (S. cernuus), a perennial floodplain plant, were obtained along Transects A, B, and C and comparable floodplain areas of the background site. The soil was loosened around the base of the plant so that a portion of the rhizome could be easily pulled from the ground. Composite, whole specimen samples (subsurface and aerial plant sections) were obtained for chemical analysis.

Crayfish (Procambarus acutus)

A variety of techniques were used to obtain sufficient crayfish for composite sample analysis. Seines, crayfish drags, crayfish traps, and burrow excavation were employed during sample collection. In general, crayfish were easier to obtain in standing water areas near Transects B and C. Crayfish were obtained from these areas using a crayfish drag or seines. Crayfish drags or seines were ineffective for sample collection at the background site. Background crayfish samples were collected using baited traps and by burrow excavation. Crayfish sample were matched for species and to the extent possible, specimen size.

Fish

Largemouth bass (Micropterus salmoides) and channel catfish (Ictalurus punctattus) were obtained using traditional fishing techniques (angling and baited trot lines). Artificial lures were used to catch bass while catfish were caught using catalpa worms as bait. Fish were placed on dry ice in a decontaminated ice chest following sample collection. In most cases, fish were submitted to the analytical laboratory as single, whole organism samples; however, two channel catfish samples from the background area required a composite of two fish to achieve adequate sample weight.

Amphibians (Bufo terrestris)

Southern toads (B. terrestris) were caught by hand from Transects A, B, and C and comparable floodplain areas of the background site. Composite samples were required to provide adequate sample weight for chemical analysis.

Reptiles (Aqkistrodon piscivorus)

Cottonmouth snakes (A. piscivorus) were collected using reptile snares at Transects A, B, and C and comparable floodplain areas of the background site. Snakes were killed by a blow behind the head with the blunt edge of a machete. Snakes were submitted to the analytical laboratory as single, whole animal samples.

Small Mammals

The small mammal collection was abandoned due to the inability to capture rats or mice in the floodplain areas of either the Ciba-Geigy Corporation property or the background site during approximately 12 days of collection effort (40-60 snap traps set per night, 660 total trap-nights). The inability to capture small mammals will not have a major impact on the overall ecological study results.

Large Mammals (Procyon lotor)

Live traps were ineffective for raccoon collection. All specimens were shot in the head using a scoped .22 caliber rifle using short rim fire ammunition. Raccoons were collected in wooded areas near sampling Transects A, B, and C, and in similar habitat areas of the background site.

6.3.2 Results Of Analyses

Plant (Saururus cernuus)

Table 6-8 presents the reported values for target analytes in plant tissues. Five of the seven heavy metal analytes were detected in the plant tissues. In general the levels of arsenic, cadmium, chromium, and mercury are similar in the study area plants and in background. The highest concentration of nickel (438 mg/kg) was reported from sample PL-BG2.

Among the target pesticides only the DDT group compounds were found and these were at levels below 0.01 mg/kg. All isomers of the DDT group were found in specimens collected at Transect A, and two isomers (4,4'-DDD and 2,4'-DDE) were found in all samples including those collected in the background locations. 2,4'-DDE was found in plants at all transects in the study area at comparable levels (0.003 to 0.004 mg/kg), but not in background. The 4,4'- and 2,4' isomers of DDT were found only in plants collected at Transect A (PL-A) . Total residues of all DDT group isomers, or DDTR, ranges from 0.0117 to 0.0293 mg/kg in study area plants and 0.0040 to 0.0094 mg/kg in the background samples. No correlation was apparent between DDTR concentrations in plants and soils collected from the same general area in the floodplain. Plants collected from Transects B and C had similar DDTR concentrations. However Transect B soils from this location (B4) contained approximately 0.5 mg/kg DDTR. While DDT group compounds were not detected in any Transect C soil samples.

Crayfish (Procambarus acutus)

The results of tissue analyses are presented in Table 6-9. All heavy metals were detected in crayfish tissue. Selenium was detected only in the three background samples at levels which range from 0.00017 to 0.00021 mg/kg. There is no apparent elevation of heavy metals in crayfish collected in the study area although there appears to be a marginal elevation of arsenic, nickel and zinc in some samples collected in the background area. Similar concentrations of inorganic analytes were measured in crayfish collected near Transects B and C.

All of the DDT group compounds were found in crayfish tissues with 4 4'-DDD, 4,4'-DDE and 2,4'-DDE occurring in all samples including background; 2,4'-DDD was found only in samples taken from the central drainage (CY-A and CY-B) while 2,4'-DDT was detected only in sample CY-C and in background sample CY-BG1. 4,4'-DDT was detected in the three study areas samples but not in background. The average DDTR is 2.2 mg/kg in the study area crayfish and 0.047 mg/kg in background samples. No correlation was observed between concentrations of DDTR in crayfish and concentrations in sediment collected from the central floodplain drainage (B3, C3) .

Fish

Largemouth Bass (Micropterus salmoides)

The results from analyses of whole body samples of largemouth bass are presented in Table 6-10. All heavy metals except cadmium were detected in fish tissues. Selenium was detected in four of the six samples taken from Olin Basin which yielded values from 0.1 to 0.3 mg/kg. Chromium, mercury and zinc were detected in all samples. Chromium levels were highest in fish from Boykin Pond with an average concentration of 0.44 mg/kg compared to 0.39 and 0.23 mg/kg in the background area and Olin Basin respectively. The highest average mercury concentration was obtained in fish from Boykin Pond (0.68 mg/kg) but the highest concentration (0.93 mg/kg) was reported for sample LB-D3 from Olin Basin (average 0.58 mg/kg). The average concentration of mercury obtained from background samples was 0.23 mg/kg. No correlation was apparent between tissue concentrations of inorganic analytes in largemouth bass and concentrations present in surface water or sediment.

TABLE 6-8

TISSUE ANALYSES
PLANTS

Analytes	PL-A	PL-B	PL-C	PL-BG1	PL-BG2	PL-BG3
INORGANICS (mg/kg)						
Arsenic	ND	ND	0.20 J	0.70 J	0.22 J	0.36 J
Cadmium	ND	ND	2.7	ND	19.5	ND
Chromium	0.23	0.18	0.13	0.12	0.32	0.18
Mercury	0.010	0.010	0.010	0.010	0.010	0.010
Nickel	0.34 J	0.46 J	25.4 J	0.77 J	438 J	1.0 J
Selenium	ND	ND	ND	ND	ND	ND
Zinc	ND	ND	ND	ND	ND	ND
ORGANICS (mg/kg)						
4,4'-DDT	0.0070 J	ND	ND	ND	ND	ND
4,4'-DDD	0.0045 J	ND	ND	ND	ND	ND
4,4'-DDE	0.0079	0.0058	0.0044	0.0075	0.0025	0.0056
2,4'-DDT	0.0036 J	ND	ND	ND	ND	ND
2,4'-DDD	0.0036	0.0023	0.0066	0.0019	0.0015	0.0019
2,4'-DDE	0.0027 J	0.0036 J	0.0040 J	ND	ND	ND
Tolban r	ND	ND	ND	ND	ND	ND
Chlorobenzilate	ND	ND	ND	ND	ND	ND
Diazinon	ND	ND	ND	ND	ND	ND
% lipids	0.55	0.47	0.82	0.77	0.86	0.69

J = approximate concentration
ND = not detected (below detection limit)

TABLE 6-9

TISSUE ANALYSES
CRAYFISH

Analytes	CY-A	CY-B	CY-C	CY-BG1	CY-BG2	CY-BG3
INORGANICS (mg/kg)						
Arsenic	0.19 J	0.19 J	0.17 J	0.47 J	0.47 J	0.28 J
Cadmium	0.080 J	0.50 J	0.18 J	0.80	ND	ND
Chromium	0.35	0.32	0.37	0.30	0.38	0.29
Mercury	0.030	0.030	0.020	0.030	0.050	0.040
Nickel	0.53	1.3	1.1	4.9 J	0.33 J	0.23 J
Selenium	ND	ND	ND	0.21 J	0.19 J	0.17 J
Zinc	12.4 J	12.0 J	13.2 J	22.1 J	19.7 J	18.2 J
ORGANICS (mg/kg)						
4,4'-DDT	0.2639	0.0816	0.3230 J	ND	ND	ND
4,4'-DDD	0.4074	0.4971	0.3271 J	0.0089 J	0.0032 J	0.0022 J
4,4'-DDE	0.8467	0.7255	2.2625	0.0609	0.0270	0.0163
2,4'-DDT	ND	ND	0.1230	0.0073 J	ND	ND
2,4'-DDD	0.0474	0.0512	ND	ND	ND	ND
2,4'-DDE	0.1287	0.1271	0.4976 J	0.0080 J	0.0053 J	0.0034 J
Tolban r	ND	ND	ND	ND	ND	ND
Chlorobenzilate	ND	ND	ND	ND	ND	ND
Diazinon	ND	ND	ND	ND	ND	ND

J = approximate concentration
ND = not detected (below detection limit)

All DDT group compounds were detected in largemouth bass tissues although 2,4'-DDT was found in only one (LD-D5) of the 12 samples analyzed. 4,4' and 2,4-DDE were found in all samples including background samples. The dominant isomer in all samples is 4,4'-DDE which accounts for 41 to 51% of the DDTR in Olin Basin 68 to 78% in samples from Boykin Pond and 71 to 88.7% of the DDTR in the background area.

The total for all isomers (DDTR) in the background area ranged from 0.074 to 0.455 mg/kg; Boykin pond samples ranged from 0.602 to 0.769 mg/kg while in Olin Basin samples range from 11.192 to 44.780 mg/kg. DDT group compounds, were not detected in surface water collected from the background area, Boykin Pond, or Olin Basin. DDTR concentrations in Boykin Pond and Olin Basin sediment were 0.6 and 4.2 mg/kg, respectively. DDT group compounds were not detected in background area sediments.

Catfish (Ictalurus punctatus)

Results from analysis of twelve, whole body catfish samples are presented in Table 6-11. Chromium, mercury, nickel and zinc were detected in all samples. The data suggest an elevation in mercury levels (less than 1 order of magnitude) in fish collected from Olin Basin and Boykin Pond. Olin Basin has the highest overall average concentration (0.33 mg/kg in Olin Basin, 0.16 mg/kg in Boykin Pond, and 0.053 mg/kg in background). Sediment concentrations of mercury were also higher in Olin Basin (D3, 28 mg/kg) as compared to Boykin Fond (E3, 0.18 mg/kg) and the background area (BG-2, - 0.07 mg/kg) 4,4'-DDD and 4,4'-DDE were the predominant isomers in fish tissues.

These isomers were found in all fish samples, except Boykin Pond sample CF-E1 which contained only 4,4'-DDD. In Olin Basin specimens, 2,4'-DDD and 2,4'-DDE were seen in all samples. DDT (4,4' and 2,4'- isomers) was found only at low levels and only in Olin Basin samples. The average DDTR in Olin Basin samples is 11.940 mg/kg, while in Boykin Pond and in background average DDTR is 0.179 mg/kg and 0.108 mg/kg respectively. DDT group compound, were not detected in surface water collected from the background area, Boykin Pond, or Olin Basin. DDTR concentrations in Boykin Pond and Olin Basin sediment were 0.6 and 4.2 mg/kg, respectively. DDT group compounds were not detected in background area sediments.

Amphibians (Bufo terrestris)

The results from analyses of whole body samples of southern toads are represented in Table 6-12. Six heavy metal analytes were detected in all toad samples. Cadmium was detected in only one sample (TD-BG1) in the background area. The levels measured for these six metals are similar in study area toads and background samples. No correlation was observed between concentrations of inorganics in toad sample and soils or sediments collected from similar areas of floodplain.

Table 6-10
TISSUE ANALYSES
BASS

Analytes	LB-D1	LB-D2	LB-D3	LB-D4	LB-DS	LB-D6	LB-E1	LB-E2	LB-E3	LB-BG1	LB-BG2	LB-BG3
INORGANICS (mg/kg)												
Arsenic	ND	ND	0.60 J	0.13 J	0.50 UJ	0.20 J	0.050 J	0.050 J	ND	ND	ND	0ND
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	0.21	0.17	0.24	0.31	0.20	0.25	0.49	0.38	0.45	0.42	0.41	0.36
Mercury	0.43	0.47	0.93	0.66	0.76	0.24	0.83	0.72	0.51	0.22	0.27	0.20
Nickel	0.21	0.24	0.22	0.20	0.12	ND	0.14	ND	ND	0.13	ND	ND
Selenium	ND	ND	0.17 J	0.19 J	ND	0.32 J	ND	ND	ND	ND	ND	ND
Zinc	8.7 J	8.3 J	8.9 J	10.6 J	7.5 J	9.9 J	10.7 J	9.5 J	11.2 J	10.6 J	12.4 J	9.1 J
ORGANICS (mg/kg)												
4,4'-DDT	0.3696	0.8011	1.0257	1.2155 J	1.2694	2.8260	0.0146 J	0.0257 J	0.0739 J	ND	ND	ND
4,4'-DDD	3.1588	5.8902	7.1781	5.9861 J	13.1521	12.7833	0.0944 J	0.1589 J	0.0786 J	ND	ND	0.1159
4,4'-DDE	4.5878	9.1089	15.4026	12.5063	21.0915	18.7371	0.4099	0.4730	0.5928	0.0663	0.1686	0.3273
2,4'-DDT	ND	ND	ND	ND	0.9431	ND	ND	ND	ND	ND	ND	ND
2,4'-DDD	1.2470	1.7574	1.8912	2.2388 J	2.6016	3.6589 J	0.0163 J	ND	ND	ND	ND	ND
2,4'-DDE	1.8285	4.0629	5.1987	2.3804	5.7226	6.2533	0.0675	0.0312	0.0234	0.0085	0.0286	0.0115
Tolban r	ND	0.0426	ND	ND	0.054.46	ND	ND	ND	ND	ND	ND	ND
Chlorobenzilate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diazinon	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

J = approximate concentration
ND = not detected (below detection limit)
Tolban r was detected in only two of the 12 fish analyzed, Measured values were 0.043 and 0,055 mg/kg in samples LB-D2 and LB-D5 respectively.

Table 6-11
TISSUE ANALYSES
CATFISH

Analytes	CF-D1	CF-D2	CF-D3	CF-D4	CF-D5	CF-D6	CF-E1	CF-E2	CF-E3	CF-BG1	CF-BG2	CF-BG3
INORGANICS (mg/kg)												
Arsenic	ND	ND	ND	0.10 J	ND	ND	ND	ND	ND	ND	0.050 J	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	0.13	0.19	0.21	0.39	0.17	0.36	0.24	0.31	0.22	0.39	0.39	0.49
Mercury	0.070	0.33	0.33	0.51	0.26	0.49	0.13	0.15	0.20	0.060	0.060	0.040
Nickel	0.27	0.25	0.29	0.43	0.28	0.50	0.24	0.15	0.23	4.9	0.13	0.21
Selenium	ND	ND	ND	ND	ND	ND	0.18 J	0.18 J	0.20 J	0.19 J	0.17 J	ND
Zinc	9.1 J	9.0 J	10.9 J	11.5 J	10.9 J	10.7 J	11.9 J	11.6 J	10.7 J	25.8 J	16.9 J	19.0 J
ORGANICS (mg/kg)												
4,4'-DDT	ND	0.1043	0.1547	0.0658	ND	0.5291	ND	ND	ND	ND	ND	ND
4,4'-DDD	0.3695	0.2066	1.8355	1.3403	13.0471	3.7930	0.0525	0.0476 J	0.0204 J	0.0195	0.0387	0.0175
4,4'-DDE	0.2691	0.3855	4.2839	2.8072	16.9618	6.0392	ND	0.1982	0.1250	0.0580	0.1054	0.0754
4,4'-DDT	0.0489	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	0.1742	0.1053	0.4084	0.2686	4.0325	0.9002	ND	0.020 J	0.0113 J	ND	ND	ND
4,4'-DDE	0.3033	0.1953	1.3972	0.9882	7.6505	2.9768	ND	0.0426	0.0211	ND	ND	11.20
Colban r	ND	ND	ND	ND	0.0391	ND	ND	ND	ND	ND	ND	ND
Chlorobenzilate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diazinon	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
% lipids	8.09	5.56	3.88	3.49	6.87	1.78	6.36	3.54	2.76	2.54	3.54	2.76

J = approximate concentration
ND = not detected (below detection limit)

TABLE 6-12
TISSUE ANALYSES
TOAD

Analytes	TD-A	TD-B	TD-C	TD-BG1	TD-BG2	TD-BG3
INORGANICS (mg/kg)						
Arsenic	0.070 J	0.10 J	0.090 J	0.060 J	0.050 J	0.070 J
Cadmium	ND	ND	ND	0.040 J	ND	ND
Chromium	0.47	0.46	0.37	0.39	0.36	0.39
Mercury	0.070	0.060	0.060	0.060	0.060	0.070
Nickel	0.12	0.48	0.12	0.57	0.13	1.6
Selenium	0.19	0.18	0.19	0.24 J	0.24 J	0.26
Zinc	30.6 J	15.8 J	18.9 J	18.2 J	18.3 J	19.5 J
ORGANICS (mg/kg)						
4,4'-DDT	1.5374	0.0828	0.0531 J	ND	ND	ND
4,4'-DDD	0.1414	0.0342	ND	0.0064	ND	ND
4,4'-DDE	3.6203	2.7089	0.4817 J	ND	0.0031	0.0032
2,4'-DDT	ND	ND	ND	ND	ND	ND
2,4'-DDD	ND	ND	ND	ND	ND	ND
2,4'-DDE	0.0651	0.0758	ND	ND	ND	ND
Tolban r	0.0179	ND	ND	ND	ND	ND
Chlorobenzilate	ND	ND	ND	0.0345	ND	ND
Diazinon	ND	ND	ND	ND	ND	ND
% lipids	2.88	1.98	2.64	1.38	1.51	1.34

d = approximate concentration
ND = not detected (below detection limit)

The predominant DDT group compounds detected in study area toads are 4,4'-DDT and 4,4'-DDE which together account for 96 to 100% of the total body burdens. The concentrations of these isomers range from approximately 0.482 mg/kg to 3.62 mg/kg for 4,4'-DDE and 0.053 mg/kg to 1.537 mg/kg for 4,4'-DDT. 4,4'-DDD and 4,4'-DDE were detected in toad samples from the background site. Tolban r was detected in one study area sample (TD-A) and chlorobenzilate was detected in one of three background samples. DDTR concentrations in toads were compared to concentrations in soil or sediment collected from similar locations. Toad samples collected near Transects A, B, and C contained DDTR concentrations of 5.4, 2.9 and 0.5 mg/kg, respectively. Soil or sediment sampled near these toad collection locations contained 1.3 (A4), 9.3 (B3), and 0.02 mg/kg (F7) of DDTR.

Reptiles (Aqkistrodon piscivorus)

Table 6-13 presents the results from whole body analysis of snake samples. There is no apparent elevation of heavy metals in the reptile tissues in the study area. Cadmium was not detected in any of the samples; the remaining heavy metals were detected in all samples at comparable levels.

Two isomers of the DDT grohp, 4,4'-DDE and 2,4'- DDT were detected in all samples from the study area and from the background area. The dominant residue is 4,4'-DDE which constitutes 97.6 to 98.5% of the total body burden in the study area and 78.5 to 89.6% of the total body burden in the background samples.

DDTR ranges from 2.990 mg/kg to 27.817 mg/kg in the study area samples and 0.057 mg/kg to 0.370 mg/kg in background samples.

Raccoon (Procyon lotor)

Fat

The results from analysis of fatty tissues taken from raccoons are presented in Table 6-14. Three samples were analyzed from the study area and three from background. Four inorganic analytes, chromium, mercury, nickel, and zinc were found in study area and background area fat specimens. The reported levels for heavy metals are similar in the study area and background animals.

Table 6-13
TISSUE ANALYSES
REPTILE

Analytes	SN-A	SN-B	SN-C	SN-BG1	SN-BG2	SN-BG3
INORGANICS (mg/kg)						
Arsenic	0.15 J	0.080 J	0.090 J	0.18 J	0.090 J	0.090 J
Cadmium	ND	ND	ND	ND	ND	ND
Chromium	0.94	0.53	0.62	0.63	0.76	0.57
Mercury	0.50	0.41	0.74	0.46	0.55	0.50
Nickel	0.56 J	0.20 J	0.28 J	0.34 J	0.19 J	0.21 J
Selenium	0.35 J	0.33 J	0.42 J	0.25 J	0.32 J	0.44 J
Zinc	19.4 J	16.8 J	20.7 J	21.5 J	20.3 J	16.3 J
ORGANICS (mg/kg)						
4,4'-DDT	ND	ND	ND	ND	ND	ND
4,4'-DDD	0.075 J	ND	ND	ND	0.0276 J	ND
4,4'-DDE	9.7000	2.9398	27.3999	0.0449	0.3161	0.1238
2,4'-DDT	0.1300 J	0.0506 J	0.4175 J	0.0123 J	0.0228 J	0.0143 J
2,4'-DDD	0.0122 J	ND	ND	ND	ND	ND
2,4'-DDE	0.0240 J	ND	0.0331 J	ND	0.0042 J	ND
Tolban r	ND	ND	ND	ND	ND	ND
Chlorobenzilate	ND	ND	ND	ND	ND	ND
Diazinon	ND	ND	ND	ND	ND	ND
% lipids	1.26	2.07	2.62	0.99	2.00	3.77

J = approximate concentration
ND = not detected (below detection limit)

All DDT group compounds except 2,4'-DDT were found in study area samples. 4,4'-DDD, 4,4'-DDE and 2,4'-DDE were found in background fat samples. Average DDTR in the study area is 17.1 mg/kg, compared to 0.022 mg/kg in background. The predominant isomer in raccoon fat is 4,4'-DDE which accounts for 73.5 to 99% of the DDTR body burden in study area raccoons. No correlation was observed between concentrations of DDTR in raccoon fat and concentrations of DDTR in surface water and sediment collected from similar transect locations. Also, no correlation was found between DDTR concentrations in crayfish and DDTR concentrations in raccoon fat from specimens collected from similar locations. This lack of geographic correlation is probably due to the size of the feeding range of the raccoon.

Muscle

Table 6-15 presents the data from analyses of muscle tissue of raccoons. As with raccoon fat chromium, mercury and zinc were found in all specimens. The data suggest a slight elevation of mercury above background levels in study area samples.

Four of the DDT group compounds were found in study area samples. Only 4,4'-DDE was found in all three study area samples while 4,4'-DDT, 4,4'-DDD, and 2,4'-DDE were each found in two study area samples. DDT group isomers were not detected in background samples of muscle tissue. DDTR ranges from 0.059 mg/kg to 0.763 mg/kg.

Liver

Table 6-16 presents the data from analyses of liver tissue of raccoons. Cadmium, chromium, mercury and zinc were measured in all samples. The levels of metals in the study area samples are comparable to those in the background samples with the possible exception of mercury in one sample (RC-A). The 4,4'-isomers of DDT, DDD, and DDE were detected in study area raccoon liver samples. 4,4'-DDE was also detected in one background sample. Chlorobenzilate was detected in a single background raccoon liver sample (RC-BG3).

Table 6-14
TISSUE ANALYSES
RACCOON FAT

Analytes	RC-A	RC-B	RC-C	RC-BG1	RC-BG2	RC-BG3
INORGANICS (mg/kg)						
Arsenic	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND
Chromium	0.64	0.38	0.27	0.11	0.17	0.19
Mercury	0.19 J	0.12 J	0.010 J	0.19 J	0.28	0.11
Nickel	0.30	0.14	0.15	ND	0.17	ND
Selenium	ND	ND	ND	ND	ND	ND
Zinc	9.6 J	5.1 J	1.9 J	36.8 J	44.7 J	43.5 J
ORGANICS (mg/kg)						
4,4'-DDT	ND	1.1695 J	2.0982	ND	ND	ND
4,4'-DDD	0.0194	1.3602	3.8260	ND	0.0088	ND
4,4'-DDE	2.0175	22.4448	17.8826	0.0098	0.0354	ND
2,4'-DDT	ND	ND	ND	ND	ND	ND
2,4'-DDD	ND	ND	0.1175	ND	ND	ND
2,4'-DDE	ND	0.0846	0.4058 J	0.0135	ND	ND
Tolban r	ND	ND	ND	ND	ND	ND
Chlorobenzilate	ND	ND	ND	ND	ND	ND
Diazinon	ND	ND	ND	ND	ND	ND

J = approximate concentration
ND = not detected (below detection limit)

Table 6-15
TISSUE ANALYSES
RACCOON MUSCLE

Analytes	RC-A	RC-B	RC-C	RC-BG1	RC-BG2	RC-BG3
INORGANICS (mg/kg)						
Arsenic	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	0.11 J
Chromium	0.24	0.11	0.14	0.35	0.11	0.14
Mercury	1.2	0.35	0.37	0.020	0.020 J	0.21 J
Nickel	0.30	ND	ND	0.20	0.39	ND
Selenium	ND	ND	ND	ND	ND	ND
Zinc	40.7 J	28.9 J	38.1 J	2.7 J	3.4 J	28.1 J
ORGANICS (mg/kg)						
4,4'-DDT	0.0025 J	0.0315 J	ND	ND	ND	ND
4,4'-DDD	ND	0.0429	0.0669	ND	ND	ND
4,4'-DDE	0.0562	0.6826	0.4286	ND	ND	ND
2,4'-DDT	ND	ND	ND	ND	ND	ND
2,4'-DDD	ND	ND	ND	ND	ND	ND
2,4'-DDE	ND	0.0056	0.0054	ND	ND	ND
Tolban r	ND	ND	0.0026	ND	ND	ND
Chlorobenzilate	ND	ND	ND	ND	ND	ND
Diazinon	ND	ND	ND	ND	ND	ND

J = approximate concentration
ND = not detected (below detection limit)

Table 6-16
TISSUE ANALYSES
RACCOON LIVER

Analytes	RC-A	RC-B	RC-C	RC-BG1	RC-BG2	RC-BG3
INORGANICS (mg/kg)						
Arsenic	ND	ND	ND	ND	ND	ND
Cadmium	0.13 J	0.10 J	0.41 J	0.11 J	0.18 J	ND
Chromium	0.14	0.21	0.19	0.13	0.11	0.11
Mercury	4.8	1.8	2.6	0.87	1.6	0.010
Nickel	ND	ND	ND	ND	0.48	0.13
Selenium	ND	ND	ND	ND	ND	ND
Zinc	19.6 J	53.9 J	40.4 J	26.9 J	25.6 J	2.5 J
ORGANICS (mg/kg)						
4,4'-DDT	ND	ND	0.1532 J	ND	ND	ND
4,4'-DDD	ND	0.1948	0.1677	ND	ND	ND
4,4'-DDE	0.1012	1.8063	0.5153	ND	ND	0.0154
2,4'-DDT	ND	ND	ND	ND	ND	ND
2,4'-DDD	ND	ND	ND	ND	ND	ND
2,4'-DDE	ND	ND	ND	ND	ND	ND
Tolban r	ND	ND	ND	ND	ND	ND
Chlorobenzilate	ND	ND	ND	ND	ND	0.0130
Diazinon	ND	ND	ND	ND	ND	ND

J = approximate concentration
ND = not detected (below detection limit)

6.3.3 Summary/Discussion

Correlation of tissue levels with concentrations in abiotic media (water, sediments, soils) cannot be made, except perhaps in a most general fashion with the existing data. Animal species which have been exposed to sufficient concentrations of bioaccumulative substances for a sufficient period may develop higher tissue concentrations of these substances than the same species exposed to lower concentrations for the same period or to the same concentration for a shorter period.

Tissue concentrations of inorganic analytes in the target species are comparable in specimens collected in the study area and in the background area. The difference between the average concentration of individual analytes in the study area specimens and background area specimens is less than one order of magnitude in all species with one exception. There is a discernable elevation in mercury levels in catfish taken from Olin Basin which average 0.33 mg/kg mercury (six samples) compared to background where the average is 0.05 mg/kg (three samples) and Boykin Pond with 0.16 mg/kg (three samples). In addition, results from the data collected during the 1994 additional field activities conducted in the Olin Basin indicate that maximum DDTR concentrations are as high as 81 ppm.

In general, tissue samples collected in the study area contain higher levels of DDT group compounds than did those collected in background. Each of the six DDT group compounds was found in at least one biotic sample in both the study area and in the background area. 4,4'-isomers account for 86.6% (average % in each sample) of the DDTR in the 60 samples which contained DDT group compounds. 4,4'-DDE was found to be present at a higher concentration than all other isomers in 57 of the 59 samples in which 4,4-DDE was identified.

Table 6-17 presents a summary of chemicals detected in terresterial biota. The summary tables present the frequency of detection, the mean, the number of samples used to calculate the mean, the range of detection limits, and the range of detection concentrations.

Based on data in the RI Report, EPA's assessment indicates that levels of DDTR measured in surface water at the Site may pose a hazard to aquatic life. In addition, fish eating birds and mammals, as well as insect eating birds appear to be at risk from exposure to DDTR or related pesticides via food, water and sediment ingestion.

Table 6-17

SUMMARY OF CHEMICALS DETECTED IN TERRESTRIAL BIOTA
ECOLOGICAL ASSESSMENT

(Concentrations reported in mg/kg tissue; organics as wet weight, inorganics as dry weight, as reported by laboratory)

Chemical (a)	Frequency of Detection (b)	Mean Sample Size (c)	Mean Concentration (d,e)	Range of Detection Limits (d,f)	Range of Detected Concentrations (d) On site	Range of Detected Concentrations (d) Background (f,g)
CRAYFISH						
Organics:						
* DDD	3 / 3	3	0.444	NA	0.328 - 0.548	0.0025 - 0.0092
* DDE	3 / 3	3	1.53	NA	0.853 - 2.75	0.0197 - 0.0689
* DDT	3 / 3	3	0.267	NA	0.082 - 0.453	0.0076
Inorganics:						
Arsenic (h)	3 / 3	3	0.183	NA	0.17 - 0.19	0.3 - 0.5
Cadmium (h)	3 / 3	3	0.103	NA	0.05 - 0.18	0.1
Chromium (h)	3 / 3	3	0.347	NA	0.32 - 0.37	0.3 - 0.4
Nickel (h)	3 / 3	3	0.977	NA	0.53 - 1.3	0.2 - 4.9
Zinc (h)	3 / 3	3	12.5	NA	12 - 13.2	18.2 -22.1
Mercury (h)	3 / 3	3	0.0287	NA	0.02-0.03	0.03 -0.05
PLANT						
Organics:						
* DDD	3 / 3	3	0.00621	NA	0.00271 - 0.00814	0.0023 -0.0027
* DDE	3 / 3	3	0.00945	NA	0.00839 - 0.0106	0.003 - 0.008
* DDT	1 / 3	3	0.00409	0.00071 - 0.00096	0.0106	0.018

Inorganics:						
Arsenic (b)	1 / 3	3	0.0833	.05	0.2	0.1 - 0.4
Cadmium (h)	1 / 3	3	0.913	0.04	2.7	19.5
Chromium (h)	3 / 3	3	0.18	NA	0.13 - 0.23	0.1 - 0.3
Mercury (h)	3 / 3	3	0.01	NA	0.01	0.01
Nickel (h)	3 / 3	3	6.73	NA	0.34 - 25.4	0.8 - 438
ROCCOON (FAT)						
Organics:						
* DDD	3 / 3	3	1.78	NA	0.02 - 3.94	0.01
* DDE	3 / 3	3	14.3	NA	2.02 - 22.5	0.0232 - 0.0374
* DDT	3 / 3	3	1.13	NA	0.0668 - 2.11	ND (0.0063- 0.020)
Inorganics:						
* Chromium	3 / 3	3	0.43	NA	0.27 - 0.64	0.1 - 0.2
Mercury (h)	3 / 3	3	0.107	NA	0.01 - 0.19	0.1 - 0.3
Nickel (h)	3 / 3	3	0.197	NA	0.14 - 0.3	0.2
Zinc (h)	3 / 3	3	5.53	NA	1.9 - 9.8	36.8 - 44.7

See footnotes at end of table.

Table 6-17 (Cont.)

SUMMARY OF CHEMICALS DETECTED IN TERRESTRIAL BIOTA
ECOLOGICAL ASSESSMENT

Concentrations reported in mg/kg tissue; organics in wet weight, inorganics in dry weight, as reported by laboratory)

Chemical (a)	Frequency of Detection (b)	Mean Sample Size (c)	Mean Concentration (d,e)	Range of Detection Limits (d,f)	Range of Detected Concentrations (d) On-site	Range of Detected Concentrations (d) Background (f,g)
RACCOON LIVER						
Organics:						
* DDD	2 / 3	3	0.123	0.0018 - 0.0078	0168 - 0.196	ND (0.00221-0.0110)
* DDE	3 / 3	3	0.809	NA	0.103 - 1.81	0.0159
* DDT	1 / 3	3	0.0543	0.00287 - 00048	0.154	ND (0.00167-0.00835)
Inorganics:						
Cadmium (h)	3 / 3	3	0.213	NA	0.1 - 0.41	0.1 - 0.2
* Chromium	3 / 3	3	0.18	NA	0.14 - 0.21	0.11 - 0.13
* Mercury	3 / 3	3	3.07	NA	1.8 - 4.8	0.01 - 1.6
Zinc (h)	3 / 3	3	38	NA	19.6 - 53.9	2.5 - 26.9
RACCOON (MUSCLE)						
Organics:						
* DDD	2 / 3	3	0.0373	0.00061 - 0.00159	0.0432 - .0671	ND (0.00221)
* DDE	3 / 3	3	0.393	NA	0.0564 - 0.088	ND (0.00161)
* DDT	2 / 3	3	0.0120	0.00096	0.00275 -,0319	ND (0.00167)
Tolban (i)	1 / 3	3	0.00217	0.00259 - 0.0052	0.00282	ND (0.0026 - 0.013)

Inorganics:

Chromium (h)	3 / 3	3	0.163	NA	0.11 - 0,24	0.1 - 0.4
* Mercury	3 / 3	3	0.64	NA	0.35 - 1.2	0.01 - 0.2
Nickel (h)	1 / 3	3	0.14	0.12 - 0.12	0.3	0.2 - 0.4
* Zinc	3 / 3	3	35.9	NA	28.9 - 40.7	2.7 - 28.1

SNAKE

Organics:

* DDD	1 / 3	3	0.0418	0.00061 - 0.048	0.0781	0.0279
* DDE	3 / 3	3	13.4	NA	2.94 - 27.4	0.0464 - 0.320
* DDT	3 / 3	3	0.206	NA	0.0524 - 0.423	0.0134 - 0.0231

Inorganics:

Arsenic (h)	3 / 3	3	0.107	NA	0.08 - 0.15	0.1 - 0.2
Chromium (h)	3 / 3	3	0.697	NA	0.63 - 0.94	0.6 - 0.8
Mercury (h)	3 / 3	3	0.55	NA	0.41 - 0.74	0.5 - 0.6
Nickel (h)	3 / 3	3	0.347	NA	0.2 - 0.56	0.2 - 0.3
Selenium (h)	3 / 3	3	0.387	NA	0.33 - 0.42	0.3 - 0.4
Zinc (h)	3 / 3	3	19	NA	16.8 - 20.7	16.3 - 21.5

See footnotes at end of table.

Table 6-17 (Cont.)

SUMMARY OF CHEMICALS DETECTED IN TERRESTRIAL BIOTA
ECOLOGICAL ASSESSMENT

Concentrations reported in mg/kg tissue; organics in wet weight, inorganics in dry weight, as reported by laboratory)

Chemical (a)	Frequency of Detection (b)	Mean Sample Size (c)	Mean Concentration (d,e)	Range of Detection Limits (d,f)	Range of Detected Concentrations (d) On-site	Range of Detected Concentrations (d) Background (f,g)
TOAD						
Organics:						
* DDD	2 / 3	3	0.0644	0.00365 - 0.02	0.035 - .142	0.0067
* DDE	3 / 3	3	2.32	NA	0.485 - 3.69	0.0036 - 0.0037
* DDT	3 / 3	3	0.562	NA	0.0561 -1.54	ND (0.00167)
Tolban (i)	1 / 3	3	0.014	0.0156 - 0.0325	0.002	ND (0.0020)
Inorganics:						
Arsenic (h)	3 / 3	3	0.0867	NA	0.07 - 0.1	0.05 - 0.07
Chromium (h)	3 / 3	3	0.433	NA	0.37 - 0.47	0.38 - 0.89
Mercury (h)	3 / 3	3	0.0633	NA	0.06 - 0.07	0.06 - 0.07
Nickel (h)	3 / 3	3	0.24	NA	0.12 - 0.48	0.1 - 1.8
Selenium (h)	3 / 3	3	0.187	NA	0.18 - 0.19	0.2 - 0.3
Zinc (h)	3 / 3	3	21.8	NA	15.8 - 30.6	18.2 - 19.5

*	= Chemical of potential concern. See text for a description of procedures used to select chemicals of potential concern.
NA	= Not applicable; chemical detected in every sample or non-detected samples had high detection limits such that one-half of the detection limit exceeded the maximum detected value. (These values were excluded from the data and summary. See text.)
ND	= Not detected. (Detection limits in parentheses.)
NC	= Not calculated; only one sample available for mean calculation.

(a) Values presented for DDT and metabolites are the sum of values for the o,p'- and p,p'- isomers.
(b) The number of samples in which the chemical was detected divided by the total number of samples analyzed.
(c) The number of samples used to calculate the mean.
(d) Values rounded to no more then three significant figures.
(e) Mean calculated for normal distribution.
(f) Detection limits are only those for which one-half of the detection limit was less than the maximum detected value. See text.
(g) Background samples collected from the Stimpson Wildlife Sanctuary, located up-river from the CIBA-GEIGY plant.
(h) Eliminated as a chemical of potential concern because concentrations were not statistically higher than background.
(i) Eliminated as a chemical of potential concern based on concentration-toxicity screening. See text and Appendix B.

6.4 CLEANUP GOALS

The calculation of Remedial Goal Options (RGOs) has been provided using the scenarios and assumptions utilized in EPA's conservative assessment of the site. The result of these calculations provides RGOs between 0.04 and 3.76 ppm total DDT. It should be noted that because of the high level of uncertainties, conservative assumptions were utilized in these scenarios.

For the majority of the scenarios considered, in order to achieve a HQ of 1 or less, the concentration of DDTR in the floodplain must be no greater than 1 ppm. However, remediating to 1 ppm is not practical because this would require extensive excavation and destruction of the bottom land hardwood forest and the cypress tuepelo swamp that the number was generated to protect. Given the current water management in the area, restoration of the vegetative communities would be unlikely. This level of remediation would result in unacceptable short-term and long-term impacts to ecological receptors. Also, if the swamps or wetlands are destroyed, additional land must be acquired for mitigation. In addition, remediating to 1 ppm may not be justified given the conservatism of the scenarios used in Environmental Response Team's assessment.

With the exception of the cypress swamp, results from the suite of toxicity test performed did not clearly show a trend that related concentrations of DDTR at 20 ppm in soil or sediment to adverse effects in plants or the adverse effects predicted by the levels of contaminants bioaccumulated in animal tissue.

Based on the current information, EPA has determined that 15 ppm total DDTR would provide the best balance of overall protection among cleanup goals considered for remediation of the floodplain soil/sediment. Adjustments and modifications to the cleanup goals based on area-specific factors and additional sampling results shall be considered by EPA during the Remedial Design Study. If adjustments to the cleanup level are made, such adjustments will be published in a fact sheet, ESD, or ROD Ammendment.

Based on the available data, remediation to 15 ppm would reduce site-wide contamination significantly. The applicability of remediating areas to different levels based on ecological sensitivity and contaminant risk would be evaluated further during the RD studies.

At a minimum, additional sampling would be conducted near the northeast portion of the floodplain (near stations A5 and B5; see figure 2-1 page 3) to determine if the elevated levels (at least 5 times background) of DDT present in several animal tissues are a result of additional source areas. In addition, general sampling/monitoring would be required to determine the effectiveness of the remedy. A baseline sampling event(s) along with periodic RD sampling event(s) would include the following:

> Crayfish or other resident organisms, including fish would be analyzed for DDTR residues and compared with DDTR levels in soil/sediment at the same locations. In addition, the RD sampling would establish threshold concentration in sediments or performance standards in species above which an unacceptable level of accumulation is occurring.

Due to the co-location of the contaminants, EPA has determined that remediating the DDTR to acceptable levels would also reduce other contaminants of concern to acceptable levels.

The contamination in areas of the floodplain could present an imminent and substantial endangerment to public health, welfare or the environment by actual or threatened release of contaminants to ecological endpoints such as reproductive failure or reduced growth if not addressed by the selected alternative in this document.

7.0 DESCRIPTION OF ALTERNATIVES

The floodplain area contains approximately 2500 cubic yards of contaminated soil or sediment above 15 ppm DDTR. The following section describes the alternatives considered for the remediation of the contamination in the floodplain area (Operable Unit #3) at the site. More detailed information can be found in the OU #3 Remedial Investigation / Ecological Assessment Report and the Feasibility Study Report Addendum found in the Administrative Record. ($750,000 has been added to both Alternatives two and three to allow for the additional studies and the performance monitoring that will be conducted during the Remedial Design)

7.1 ALTERNATIVE 1: No Action

Superfund requires that the "No Action" Alternative be evaluated to establish a baseline for comparison. For this operable unit, no remedial action constitutes total dependence on natural biodegradation and/or attenuation throughout the entire floodplain land surface.

7.2 ALTERNATIVE 2: In-situ Bioremediation

This alternative focuses on application of one remedial technology in three designated areas within the Operable Unit. The three areas will be discussed below. An in-situ treatment process of the soil/sediment through a Ciba-developed, bioremediation process which establishes a two-stage anaerobic/aerobic system requiring only the addition of conditioned microbial seed, a substrate material, and a water layer over the contaminated soil (anaerobic stage). Anaerobic conditions achieve reductive dechlorination of pesticides (in this Operable Unit the compounds of concern are DDT, DDD, and DDE, commonly referred to as DDTR), and aerobic conditions further treat the dechlorinated molecules. The process is best described as an accelerated, natural, enzymatic reaction.

Based on the current data, the areas within the Operable Unit which are designated for treatment are:

1. The zone in the vicinity of Sample Point B1 at the upper end of the open Storm water Ditch (former Effluent Ditch).

2. The zone in the vicinity of Sample Point C1 at the approximate center of the open ditch.

3. The zone in the vicinity of Sample Point D1 referred to as the Cypress Swamp. Treatment would be conducted in this area based on contaminant level with no consideration of property boundary.

The remaining area within the Operable Unit (exclude 1, 2, and 3 above) is considered to be viable for No Action. Natural biodegradation and/or attenuation of organic contaminant levels is occurring in the general floodplain soil and sediment, and is adequate for protection of human health and the environment as demonstrated by site-specific risk assessment.

Following conclusion of in-situ treatment all affected areas would be restored as closely as possible to natural elevations and wildlife habitat conditions.

Soils, sediment and surface water monitoring shall be conducted at this site. After demonstration of compliance with cleanup goals, the Site including soil, sediment groundwater and resident organisms and/or fish shall be monitored. Substantial initial progress in achieving performance standards must be shown with five (5) years of attaining soil cleanup goals. If substantial progress is demonstrated, an additional five (5) years will be allowed to reach performance standards. If the results of the five year study indicates that substantial progress toward the Performance Standards set forth in the RD Additional Studies Report is not being made, additional remediation may be required.

The total present worth cost for this alternative is approximately $2,250,000.

7.3 ALTERNATIVE 3: OU #2 Treatment of Excavated soils Combined with In-situ Bioremediation

This alternative combines two remedial technologies into a synergistic strategy which addresses both the topographic and contaminant concentration profiles within the Operable Unit. Based on the current data, the specific elements of the strategy are:

1. Within the zone of the Operable Unit in the vicinity of Sample Point B1 at the upper end of the Storm water Ditch (former Effluent Ditch); and

2. The zone in the vacinity of Sample Point C1 at the approximate center of the open ditch, soils/sediments would be excavated to the 15 ppm clean-up level for DDTR.

Removed soils/sediments that exceed 500 ppm DDTR would be transported into the area of the McIntosh Site designated as OU #2 and OU #4 treatment area and processed according to the procedures for DDTR contaminated soil specified in the Records of Decision and Consent Decrees for OUs #2 and #4. Excavated soils from the floodplain that does not exceed 500 ppm DDTR would be available to be used as subsurface backfill for OU #2 areas. Soils exceeding 500 ppm DDTR would be thermally treated to meet all appropriate standard with the soils from OUs #2 and #4. The Remedial Action schedule for for OU #3 would be integrated with the OU #2 and OU #4 schedules to ensure no delay of the OU #2 and OU #4 remediations.2 Removed soil/sediment from the floodplain would be replaced with clean material of a similar soil type and vegetated to restore this area to its original elevation and wildlife habitat characteristics.

3. Within the zone of the Operable Unit in the vicinity of Sample Point D1 at the location referred to as the Cypress Swamp, sediment with concentrations of DDTR in excess of the cleanup level would be treated by application of a Ciba-developed, in-situ, anaerobic/aerobic bioremediation process as previously described in Alternative No. 2.

This treatment method would be focused on the actual DDTR contaminant profile in this area regardless of property ownership, and would be continued until DDTR concentrations in sediment are reduced to less than the cleanup goal for that area. Following conclusion of in-situ treatment, the Cypress Swamp would be restored as closely as possible to natural elevations and wildlife habitat conditions.

Based on the current information, the remaining area within the Operable Unit (exclude 1, 2 and 3 above) is considered to be viable for No Action. Natural biodegradation and/or attenuation of organic contaminant levels is occurring in the general floodplain soil and sediment, and is adequate for protection of human health and the environment as demonstrated by site-specific risk assessment.

Soils, sediment and surface water monitoring shall be conducted at this site. After demonstration of compliance with cleanup goals, the Site including soil, sediment groundwater and resident organisms and/or fish shall be monitored. Substantial initial progress in achieving performance standards must be shown with five (5) years of attaining soil cleanup goals. If substantial progress is demonstrated, an additional five (5) years will be allowed to reach performance standards. If the results of the five year study indicates that substantial progress toward the Performance Standards set forth in the RD Additional Studies Report is not being made, additional remediation may be required.

The total present worth cost to execute this alternative is approximately $1,500,000.

8.0 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

This section of the ROD provides the basis for determining which alternative provides the best balance,with respect to the statutory balancing criteria in Section 121 of CERCLA and in Section 300.430 of the NCP. The major objective of the FS was to develop, screen, and evaluate alternatives for the remediation of the contaminated soils at the Ciba-Geigy Site. A wide variety of technologies were identified as candidates for remediating the contaminated soils/sediments at the Site. These technologies were screened based on their feasibility with respect to the contaminants present and the Site characteristics. The technologies that remained after the initial screening were combined into potential remedial alternatives and evaluated in detail. The remedial alternatives selected from the screening process were evaluated using the following nine evaluation criteria:

- Overall protection of human health and the environment.
- Compliance with applicable and/or relevant Federal or State public health or environmental standards.
- Long-term effectiveness and permanence.
- Reduction of toxicity, mobility, or volume of hazardous substances or contaminants.
- Short-term effectiveness, or the impacts a remedy might have on the community, workers, or the environment during the course of implementing it.
- Implementability, that is, the administrative or technical capacity to carry out the alternative.
- Cost-effectiveness considering costs for construction, operation, and maintenance of the alternative over the life of the project, including additional costs should it fail.
- Acceptance by the State.
- Acceptance by the Community.

The NCP categorizes the nine criteria into three groups:

(1) Threshold Criteria - overall protection of human health and the environment and compliance with ARARs (or invoking a waiver) are threshold criteria that must be satisfied in order for an alternative to be eligible for selection;

(2) Primary Balancing Criteria - long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; and cost-effectiveness are primary balancing factors used to weigh major trade-offs among alternative hazardous waste management strategies; and

(3) Modifying Criteria - state and community acceptance are modifying criteria that are formally taken into account after public comment is received on the proposed plan and

incorporated into the ROE.

The selected alternative must meet the threshold criteria and comply with all ARARs or be granted a waiver for compliance with ARARS. Any alternative that does not satisfy both of these requirements is not eligible for selection. The Primary Balancing Criteria are the Technical criteria upon which the detailed analysis is primarily based. The final two criteria, known as Modifying Criteria, assess the public's and the state agency's acceptance of the alternative. Based on these final two criteria, EPA may modify aspects of a specific alternative.

The following analysis is a summary of the evaluation of alternatives for remediating Operable Unit #3 of the Ciba-Geigy Superfund Site under each of the criteria. A comparison is made between each of the alternatives for achievement of a specific criterion.

THRESHOLD CRITERIA

8.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

All of the alternatives except the "No Action" alternative would provide protection to the environment. In Alternative 1, concentrations of the contaminants in the surface water, soil and sediment would continue to potentially have an adverse impact on the ecosystem. Both Alternatives 2 and 3 would provide protection to the environment by the reduction of ecological risks to acceptable levels in the areas and to the species of concern. Alternative 3 would have the potential for higher short-term ecological risk during the period when contaminated soils are being excavated from the open ditch area, but a much lower overall long-term ecological risk because the contaminated soil is permanently removed from the area on an accelerated schedule and replaced with clean soil. In both Alternatives 2 and 3 the more ecologically areas would be treated by in-situ bioremediation. Since the "No Action" Alternative does not meet one of the threshold criteria, it would not be considered further in this discussion.

8.2 COMPLIANCE WITH ARARs

Alternatives 2 and 3 would comply with ARARs or justify a waiver. Chemical Specific ARARs would be met through compliance with the groundwater protection standards (i.e., MCLs) at the Point of Compliance as defined in Ciba-Geigy's RCRA permit and through compliance with NPDES permit conditions for water removed and treated in the contaminated areas. Soils excavated in Alternative 3 would be analyzed to determine if they are RCRA hazardous waste. If required, RCRA hazardous waste would be treated to legislative treatment standards, as adjusted pursuant to a treatability variance prior to land disposal.

8.3 LONG-TERM EFFECTIVENESS

Both Alternatives 2 and 3 would provide long-term effectiveness by permanently reducing target contaminants in soil and sediment, in specific zones of the floodplain, to values below acceptable risk levels. In Alternative 3, the combination of the two remedial technologies, removal and biotreatment, in specific zones of the floodplain area depending on both topography and contaminant concentration is the most effective method to ensure long-term ecological health in this portion of the McIntosh Site.

8.4 REDUCTION OF TOXICITY, MOBILITY OR VOLUME BY TREATMENT

Alternative 2 would reduce the toxicity and the volume of the contaminants of concern in soil and sediment by utilizing a moderately aggressive in-situ biotreatment technology. The in-situ process would not reduce the mobility of target contaminants. This is not an issue of significance, however, since the DDTR compounds are relatively immobile due to a low solubility in water. Alternative 3 would reduce toxicity, mobility and volume of contaminants threatening the ecosystem by excavating the contaminated soils and sediment which exceed the 15 ppm DDTR cleanup goal and relocating or treating them with the contaminated soils and sediment from Operable Units 2 and 4 at the Site. Excavated soils/sediments that exceed 500 ppm DDTR would be transported into the area of the McIntosh Site designated as OU #2 and OU #4 treatment area and processed according to the procedures for DDTR contaminated soil specified in the Record of Decision and Consent Decree for OUs #2 and #4. Excavated soil from the floodplain that does not exceed 500 ppm DDTR would be available to be used as subsurface backfill for the OU #2 areas. The Remedial Action schedule for for OU #3 would be integrated with the OU #2 and OU #4 schedules to ensure no delay of the OU #2 and OU #4 remediations. Excavated soils/sediments from the floodplain would be replaced with clean material of a similar soil type and vegetated to restore this area to its original elevation and wildlife habitat characteristics.

Alternative 3 would virtually eliminate a major portion of the toxic effects along with a substantial reduction in volume through excavation and/or treatment.

8.5 SHORT-TERM EFFECTIVENESS

Accomplishment of the remedial objectives for this Operable Unit is achieved in the shortest timeframe by the implementation of Alternative 3. Depending on weather conditions, the soil removal in the open ditch could be accomplished in approximately 8 months as compared to approximately 8 years to reach the remedial option goals with Alternative 2. In Alternative 3, the risks to remedial workers would be moderately higher during the soil removal phase, but are very controllable through conventional field health and safety practices with heavy emphasis on appropriate personal protective equipment. The removal of contaminated soil does increase short-term exposure of certain wildlife species to higher contaminant concentrations but this is offset by the permanent long-term reduction of the contaminants.

8.6 IMPLEMENTABILITY

The construction techniques and equipment required to prepare the treatment sites utilizing Alternatives 2 and 3 can be categorized as standard civil engineering specifications. The necessity to construct an alternative storm water drainage way in a floodplain area does limit initial field activity to relatively dry periods. The procedures and equipment for operation of the treatment process are typical to those used in conventional land farming. Alternative 2 may require periodic drainage or flooding of the soil treatment areas to create aerobic or anaerobic biological conditions, and repair or restoration of treatment sites following erosion damage due to occasional flood events. The Ciba-Geigy developed, in-situ bioremediation process has been tested on the target contaminants in the laboratory and in field pilots using actual soil from the Operable Unit. Test indicate good contamination reduction rates.

8.7 COST

The estimated total cost of Alternative 2 in 1994 dollars is $2,250,000. This estimate includes site preparation, operation of the in-situ bioremediation process for up to eight years and annual maintenance of the treatment sites throughout the treatment period. The estimated cost of Alternative 3 in 1994 dollars in $1,500,000. This estimate includes site preparation (in-situ bioremediation phase), a soil removal/processing and clean soil placement phase, an in-situ bioremediation phase for up to five years, and annual maintenance of the bioremediation treatment site throughout the treatment period.

8.8 STATE ACCEPTANCE

The State of Alabama concurs with Alternative #3 to remediate the contaminated soil/sediment in the floodplain at the Ciba-Geigy Site.

8.9 COMMUNITY ACCEPTANCE

Based on the favorable comments expressed at the December 20, 1994 public meeting and the lack of negative written comments received during the comment periods, it appears that the McIntosh community generally agrees with the selected remedy.

9.0 SELECTED REMEDY

A. SOURCE CONTROL

Based upon consideration of the requirements of CERCLA, the NCP, the detailed analysis of alternatives and public and state comments, EPA has selected a source control remedy for this operable unit. At the completion of this remedy, the risk associated with this site is expected to be protective of human health and the environment. The total present worth cost to execute the selected remedy, Alternative #3, is estimated at $1,500,000.

Source control remediation will address the contaminated soils/sediments at the Site. Source control shall include excavation of soils, sediments and related material, transportation, staging, dewatering, treatment (if necessary), placement of treated material, back filling and bioremediation.

A.1. The major components of source control to be implemented include:

Excavation of materials contaminated with greater than 15 ppm of DDTR in the floodplain area and transportation of these materials to the upland areas near the OU #2 and OU #4 remediation areas. Transported soils/sediments that do not exceed 500 ppm DDTR may be used for subsurface backfill for OU #2 areas. Transported soils/sediments that exceed 500 ppm DDTR shall be thermally treated with the OU #2 and OU #4 soils/sediments;

In-situ bioremediation for the ecologically sensitive areas (cypress swamp(s) and bottom-land hardwood forest) if Ciba-Geigy demonstrates to EPA's satisfaction that the technology will provide sufficient and timely degradation of all DDTR. In addition, Ciba-Geigy must demonstrate the timely degradation of DDTR without causing a significant adverse impact to those areas or increasing the rate of methylation of mercury in areas where the wastes are commingledo If Ciba-Geigy is unable to demonstrate to EPA's satisfaction that in-situ bioremediation will achieve all of the remedial goals for the area(s), objective #2 of the Remedial Design study below will be used to address the area(s).

A.2. Performance Standards

The Performance Standards for this component of the selected remedy include the following excavation and treatment standards:

a. Excavation Standards

Excavation shall continue until the remaining soil and material achieve a maximum concentration of 15 ppm DDTR. All excavation shall comply with ARARs, including, but not limited to OSHA and state standards. Testing methods approved by EPA shall be used to determine if the maximum DDTR concentration levels have been achieved.

During the initial phase of the Remedial Design, additional sampling activities will be conducted to accomplish the following objective:

1. To provide the baseline levels which will be used to monitor the long-term effectiveness of the remediation;

2. To determine if it is necessary to modify cleanup goals in different areas of the floodplain based on ecological sensitivity (i.e., To avoid the unnecessary destruction of habitats that may be irreplaceable by balancing the effects of the contaminants with the effects of the cleanup); and,

3. To select appropriate species to be used for measuring the effectiveness of the remedy. To establish performance standards or maximum contaminant levels in those species to determine when site remediation is successful.

If EPA modifies the cleanup goals based on the results of the Additional Studies Report, the public will be notified by a Fact Sheet, ESD or a ROD Amendment.

b. Treatment Standards

All excavated soils, sediments and related materials containing concentrations of DDTR greater than 500 ppm will be thermally treated with the OU #2 and OU #4 soils. All treatment and disposal shall comply with applicable or relevantand appropriate requirements (ARARs), including RCRA and TSCA.

Soil excavated from the floodplain (OU #3) that is below 500 ppm DDTR may be used as subsurface backfill for excavated areas of OU #2. Prohibiting the placement of soil or sediment with concentrations greater than 500 ppm DDTR will ensure that subsurface treatment levels established in the OU #2 ROD for the protection of groundwater will not be exceeded. Based on the current information, the majority of the soil and sediment would be available to be used as subsurface backfill.

B. COMPLIANCE TESTING

Soils, sediments and surface water monitoring shall be conducted at this site. After demonstration of compliance with cleanup goals, the Site including soils, sediments, groundwater, resident organisms and/or fish shall be monitored. Substantial initial progress in achieving performance standards must be shown with five (5) years of attaining soil cleanup goals. If substantial progress is demonstrated, an additional five (5) years will be allowed to reach performance standards. If the results of the five year study indicates that substantial progress toward the Performance Standards set forth in the RD Additional Studies Report is not being made, additional remediation may be required. "Substantial Progress" shall be defined during the initial phase of the Remedial Design (i.e., RD/RA negotiations or RD Workplan and Additional Studies Workplan).

In summary, Alternative 3 would achieve substantial risk reduction through excavation and/or treatment of the principal threat to the floodplain ecosystem at the Ciba-Geigy Superfund Site. Legislated treatment standards would be achieved, as adjusted pursuant to a CERCLA treatability variance for soil/sediment that exceed 500 ppm DDTR. The treatment technology which has been demonstrated to achieve these standards for the RCRA wastes present at the Site is thermal destruction. Excavated soils that do not exceed 500 ppm DDTR would be used as subsurface backfill for those areas. This action would be both protective of the environment and cost effective. Alternative 3 reduces not only the mobility of the contaminants but also the toxicity and volume of the contaminants. Alternative 3 achieves a higher level of permanent remediation by removal of contaminants from the highest concentration zones within the Operable

Unit. Alternative produces acceptable results in a significantly shorter time than other alternatives. In addition, Alternative 3 was the most cost effective of the alternatives evaluated. Based on the information available, the preferred alternative represents the best balance among the criteria used to evaluate remedies. Alternative 3 is protective of human health and the environment, would attain ARARs, would be cost effective, and would utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

10.0 STATUTORY DETERMINATION

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. Finally, it is determined that this remedy maximizes long-term effectiveness.

Because this remedy would result in hazardous substances remaining on-site, a review would be conducted within five years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

10.1 PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy protects human health and the environment through excavating and/or treating a principal threat remaining at the Site. The selected remedy provides protection of human health and the environment by eliminating, reducing, or controlling risk through treatment, relocation, engineering controls and/or institutional controls.

10.2 ATTAINMENT OF THE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Remedial actions performed under CERCLA must comply with all applicable or relevant and appropriate requirements (ARARs). All alternatives considered for the Ciba-Geigy Site were evaluated on the basis of the degree to which they complied with these requirements. The selected remedy was found to meet or exceed the following ARARs, as discussed below.

Clean Water Act

Section 404(b) of the Clean Water Act and implementing regulations will be applicable to wetlands. If excavation of the wetlands occurs during the remedial action, on-site restoration of the excavated wetlands shall satisfy mitigation requirements of this section.

Resource Conservation and Recovery Act

Many RCRA requirements are considered relevant and appropriate for remedial activities proposed at the McIntosh plant. The excavated soils and sludges will be representatively analyzed to determine if they are RCRA hazardous wastes. If RCRA hazardous waste is found it will be used as backfill in the excavated areas of Operable Units Two and Four with the soils from Operable Unit Two and Four after RCRA legislated treatment standards pursuant to a treatability variance, granted upon ROD signature, are met. EP Toxicity and TCLP analyses will be performed to ensure that treatment standards, through a treatability variance, are met. A pilot study and a trial burn will be required to ensure that the incinerator will meet the Destruction Removal Efficiencies for the contaminants at the Site. The primary activities include excavation of the majority (discression will be utilized in the ecologically sensitive areas) of soil/sediment that exceed 15 ppm: soils that exceed 500 ppm DDTR (1/10 of the most conservative of the subsurface cleanup level which was generated based on the protection of groundwater in the ROD addressing OU#2), will be incinerated, soil/sediment that are below 500ppm DDTR will be available to used as subsurface backfill in OU #2 areas, in-situ bioremediation of the ecologically sensitive areas, backfilling of the excavated areas of the floodplain with cleanfill and continuing pump and treatment of the contaminated groundwater. RCRA design standards will be incorporated into the remedial design of all construction activities so that the substantive requirements of all applicable RCRA regulations are met.

Other Guidance To Be Considered

Other Guidance To Be Considered (TBCs) include health based advisories and guidance. TBCs have been utilized in estimating incremental cancer risk numbers for remedial activities at the sites. The risk numbers are evaluated relative to the normally accepted point of departure risk range of 1x10-4 to 1x10-6.

Clean Air Act

Air emissions from the remedial activities at the Site, including thermal treatment, would be monitored to ensure compliance with the substantive requirements of the Clean Air Act. Fenceline air monitoring will be conducted to ensure that contaminant concentrations do not exceed levels considered to be safe for human health. If levels are exceeded, mitigative procedures such as dust suppression or vapor capture will be employed to prevent harmful levels of air emissions from leaving the Site.

Alabama State Water Quality Standards

Perched water at certain areas and stormwater which contacts Site materials during remediation activities will be routed through the existing on-site wastewater treatment plant. In addition, contaminated groundwater extracted by the current pump and treat system and incinerator scrubber water will be treated before discharge into the Tombigbee River through the current NPDES permit to ensure protection of aquatic life.

Waivers

No ARAR waivers are being granted however, the selected alternative will comply with the LDRs through a treatability variance for any contaminated soils and debris that would have to be treated with the OU #2 soils and sediments.

10.3 COST EFFECTIVENESS

The estimated cost of EPA's selected remedy is approximately $1,500,000. This cost does not include the RD sampling activities because the specific details of the study have not been determined. The RD study would be required regardless of the alternative selected; therefore, it would not affect the selection process. Cost effectiveness is determined by comparing the cost of all alternatives being considered with their overall effectiveness to determine whether the costs are proportional to the effectiveness achieved. EPA evaluates the incremental cost of each alternative as compared to the increased effectiveness of the remedy. The selected remedy, Alternative 3, was chosen for its high degree of effectiveness at reducing the mobility, toxicity, and volume of the contaminants and its long-term protectiveness for the ecosystem. In addition, alternative 5 is the least expensive of the alternatives that meet the threshold criteria.

10.4 UTILIZATION OF PERMANENT SOLUTIONS TO THE MAXIMUM EXTENT PRACTICABLE

EPA believes the selected remedy is the most appropriate cleanup solution for Operable Unit# 3 of the Ciba-Geigy Site and provides the best balance among the evaluation criteria of the remedial alternatives evaluated. This remedy provides effective protection in both the short-term and long-term to potential human and environmental receptors, is implementable, and is cost-effective.

Thermal treatment of the highly contaminated soils that exceed 500 ppm DDTR, with pre-treatment options proven effective during the design, and in-situ bioremediation of the more ecologically sensitive areas contaminated soil, if proven effective during the design, will effectively reduce and/or eliminate the mobility of hazardous waste and hazardous substances to the environment.

10.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The statutory preference for treatment will not be met because the selected remedy only treats the contaminated soils/sediments that exceed 500 ppm DDTR and the contamination that exist in the ecologically sensitive areas. In addition, the selected remedy allows for the relocation of the contaminated soils that are below 500 ppm DDTR to subsurface areas of OU #2. The relocation of the soils and sediments below 500 ppm DDTR removes a principal threat posed to the ecosystem without exceeding OU #2 subsurface treatment levels which were generated to ensure the protection of groundwater.

11.0 DOCUMENTATION OF SIGNIFICANT CHANGES

Following the issuance of the Proposed Plan, changes have been made to the preferred alternative in response to comments submitted to EPA during the public comment period. The Proposed Plan identified in-situ bioremediation as an alternative for addressing contamination in the more ecologically sensitive areas (swamp and bottomland hardwood forest). One commenter, raised the concern that in-situ bioremediation that is being considered for the remediation of DDTR, could have an adverse effect on Mercury in areas where the DDTR and Mercury are co-mingled (the swamp areas). The commenter expressed concern that bioremediation of the DDTR in the swamp areas could cause mercury to become more bioavailable to organisms in the area. Additional concern was raised regarding the ability of the in-situ bioremediation to reduce DDD and DDE to acceptable levels in a timely manner. The difficulty in keeping conditions favorable for effective bioremediation during seasonal changes (dry season to flood season) was questioned. Based on these concerns, the scope of RD studies has been expanded.

The additional Remedial Design Studies shall accomplish the following objectives:

1. The remedial design studies will provide the baseline levels which will be used to monitor the long-term effectiveness of the remediation.

2. To determine if it is necessary to modify cleanup goals in different areas of the floodplain based on ecological sensitivity (i.e., To avoid the unnecessary destruction of habitats that may be irreplaceable by balancing the effects of the contaminants with the effects of the cleanup).

3. To select appropriate species to be used for measuring the effectiveness of the remedy. To establish performance standards or maximum contaminant levels in those species to determine when site remediation is successful. Substantial progress in achieving performance standards must be shown within five (5) years of attaining soils/sediments cleanup goals. If substantial progress is demonstrated, an additional five (5) years will be allowed to reach performance standards. "Substantial Progress" shall be defined during the initial phase of the Remedial Design (i.e., RD/RA negotiations or RD Workplan and Additional Studies Workplan).

4. No later than the submission of the RD Additional Sampling Report, Ciba-Geigy must be able to demonstrate to EPA's satisfaction that in-situ bioremediation will provide sufficient and timely degradation of all DDTR. In addition, Ciba-Geigy must demonstrate the timely degradation of DDTR without causing significant impact to the shallow tree roots of the bottomland hardwood forest or without increasing the rate of methylation of mercury in areas where the wastes are commingled. If Ciba-Geigy is unable to demonstrate to EPA's satisfaction that in-situ bioremediation will achieve all of the remedial goals for the area(s), objective #2 of the Remedial Design study below will be used to address the area(s).

5. The results of the RD sampling activities report and any significant decisions (including but not limited to modification of cleanup level or implementation of performance standards) made by EPA in consultation with ADEM, will be released to the public in a fact sheet, ESD or ROD Amendment

In addition, the proposed plan the listed the treatment levels for DDT and its metabolites (DDT - 503 ppm, DDD - 675 ppm and DDE - 1653 ppm) and indicated that excavated soils and sediments from the floodplain that did not exceed these numbers could be used as subsurface backfill in the OU #2 areas.

In an effort to simplify the field analyses the language in the ROD has been revised as follows: Soil excavated from the floodplain (OU #3) at is below 500 ppm DDTR may be used as subsurface backfill for excavated areas of OU #2. Prohibiting the placement of soil or sediment with concentrations greater than 500 ppm DDTR will ensure that subsurface treatment levels established in the OU #2 ROD for the protection of groundwater will not be exceeded.

APPENDIX A

Responsiveness Summary

Ciba-Geigy Superfund Site

McIntosh, Washington County, Alabama

The U.S. Environmental Protection Agency (EPA) held a public comment period from December 15, 1994 to January 14, 1995 for interested parties to comment on EPA's Proposed Plan (PP) for the Ciba-Geigy Site. The comment period included a public meeting on January 20, 1995, conducted by EPA and the Alabama Department of Environmental Management (ADEM), held at the McIntosh Town Hall. The meeting presented the results of the studies undertaken and the preferred remedial alternative for remediation of the contaminated media at the Site.

A responsiveness summary is required by CERCLA (Superfund) Section 117, and it is policy to provide a summary of significant public comments and concerns about the Site, as raised during the public comment period and the public meeting, and the Agency's responses to those concerns. All comments summarized in this document have been factored into the remedy selection process for cleanup of Operable unit Three at the Site.

This responsiveness summary for the Ciba-Geigy Site is divided into the following sections:

I. Overview: This section discusses the recommended alternative for remedial action and the public's reaction to this alternative.

II. Background on Community Involvement and Concerns: This section provides a brief history of community interest and concerns regarding the Ciba-Geigy Site.

III. Summary of Major questions and Comments Received During the Public Comment Period and EPA's and ADEM's Responses: This section presents the written comments submitted during the comment period and provides EPA's responses to these comments.

IV. Remaining Concerns: This section discusses community concerns that EPA should be aware of in design and implementation of the remedial alternative for the Site.

I. Overview

The preferred remedial alternative was presented to the public in a proposed plan / fact sheet on December 15, 1994. The recommended alternative addresses the source of contamination in the floodplain by removing/treating the contaminated waste that exceed the cleanup levels.

This operable unit is the final of four operable units at the Ciba-Geigy Sites.

The major components of the selected remedy for operable unit three include:

- Excavation of approximately 2500 cubic yards of soil and sediment above the cleanup level, 15 ppm DDTR. 15 ppm DDTR has been determined to be the best balance of protection for the environment. Excavated soil and sediment would be thermally treated with the OU #2 and OU #4 soil if the concentrations is above 500 ppm DDTR. Previous RODs for cU #2 and OU #4 were signed that required excavation and thermal treatment of soil that exceeded cleanup levels which were qenerated to ensure the protection of groundwater.

Soil excavated from the floodplain (OU #3) that is below 500 ppm DDTR may be used as subsurface backfill for the excavated areas of OU #2.

- Backfilling the excavated areas with clean fill.

- In-situ bioremediation of approximately 10 acres of the more ecologically sensitive areas (cypress swamp(s) and bottom land hardwood forest) that exceed the cleanup level. if Ciba-Geigy demonstrates to EPA's satisfaction that in-situ bioremediation will provide sufficient and timely degradation of all DDTR without increasing the rate of methylation of mercury in areas where the wastes are coramingled. If Ciba-Geigy is unable to demonstrate to EPA's satisfaction that in-situ bioremediation will achieve all of the remedial goals for the area(s), the ares(s) will be addressed by objective #2 of the Remedial Design Study (below).

- Conducting Remedial Design studies to accomplish the following objectives:

    1. To provide the baseline levels which will be used to monitor the long-term effectiveness of the remediation;

    2. To determine if it is necessary to modify cleanup goals in different areas of the floodplain based on ecological sensitivity (i.e., To avoid the unnecessary destruction of habitats that may be irreplaceable by balancing the effects of the contaminants with the effects of the cleanup); and,

    3. To select appropriate species to be used for measuring the effectiveness of the remedy. To establish performance standards or maximum contaminant levels in those species to determine when site remediation is successful.

Based on the results of the Remedial Design studies, the cleanup level may be adjusted.

If adjustments to the cleanup level are made, such adjustments will be published in a fact sheet, ESD, or ROD Amendment.

II. Background on Community Involvement and Concern

The McIntosh community has been aware of the contamination problem at the Ciba-Geigy Site for several years. EPA distributed the first fact sheet to the public in August of 1989.

A public meeting was held on December 20, 1994 in McIntosh Alabama. At this meeting representatives from EPA discussed the results of the Ecological Assessment Report, presented the recommendation of EPA and ADEM for cleanup of the floodplain, answered questions and addressed community concerns.

Based on the comments received during the comment period, the public supports the approach for remediation of the floodplain at the Ciba-Geigy Site.

III. Summary of Major Questions and Comments Received During the Public Comment Period and EPA's or ADEM's Responses

The following comments were made by concerned citizens in reference to the Proposed Plan addressing the contamination in OU #3 at the Site. The Proposed Plan was released to the public in December 1994.

Comment:

1. A commenter was concerned that excavating soil/sediment that exceeded the floodplain cleanup goals and using it as backfill in excavated areas from OU #2 and OU #4 would not be protective for the other areas.

Response:

The soil from the ditch or any other area that exceeds the cleanup goal in the floodplain would be excavated to ensure the protection of the environment/ecosystem. The soils/sediments cleanup levels for OU #2 and OU #4 are based on the protection of groundwater. Since the numbers to protect the environment are more conservative than the numbers to protect the groundwater, it is likely for soils sediments to exceed the floodplain cleanup goals and be acceptable for backfill in the upland areas.

Comment:

2. A commenter was concerned that the remedy we are selecting to address the contamination may not be safe 20 years £rom now since 20 years ago, when Ciba-Geigy buried this material, it was legal.

Response:

Based on the current information and environmental regulations, we believe this remedy provides the best balance of the nine criteria as it reduces the principal threat in the floodplain. In addition, periodic monitoring will be conducted to monitor the effectiveness of the remediation. If the current environmental regulations change and the remedy is no longer protective, modifications will be made to the remedy to ensure protection to human health and the environment.

Comment:

3. A citizen expressed concern about eating fish near the Ciba-Geigy and Olin Chemicals since the Health Department issued a fish advisory recommended that the amount of fish consumption be reduced and EPA has not made a statement.

Response:

EPA released the final report on a study on the Mobile River. The report indicated that the stretch of the Tombigbee River near the Ciba-Geigy and Olin chemical plants might present an excessive risk only to a subsistence fisherman eating fish caught in this area. The Alabama Department of Public Health (ADPH) will determine the need for any statements on fish consumption.

Comment:

4. A commenter expressed a concern about EPA selecting a cleanup number of 15 ppm for DDTR in the floodplain although our models indicate that 1 ppm DDTR would be a safe cleanup number.

Response:

Although excavating to 1 ppm DDTR would allow EPA to say with confidence that the concentrations of DDTR left would not cause any harm to the plants and animals in the floodplain, the volume of soils and sediments that would have to be removed to reach 1 ppm DDTR would kill many of the plants and animals we are trying to protect. In addition, based on the current information, EPA has determined that excavating to 15 ppm DDTR would provide the best balance of removing soils and sediments that may cause harm to plants and animals while allowing areas with low levels of contamination and healthy ecosystems to remain undisturbed. Additional samples will be collected and analyzed to ensure that 15 ppm DDTR is protective. The final cleanup number may be adjusted based on the results of the studies. If the cleanup level is adjusted the public will be notified by a fact sheet, ESD or a ROD amendment.

Comment:

5. A concerned citizen asked how much the cost of the remedy would change if the cleanup numbers changed.

Response:

At this time EPA has not estimated how much the cost would change if the cleanup number changed. However, if the results from the additional studies indicated that the cleanup level needed to be changed, the new cleanup level and associated cost would be presented in a fact sheet and released to the public.

Comment:

6. A concerned citizen wanted to know when actual work in the field would begin at the Ciba-Geigy Site.

Response:

The current schedule projects construction field activities to begin early 1997. However, EPA, ADEM and Ciba-Geigy are currently looking for ways to begin the construction activities around mid-year of 1996.

Comment:

A commenter was concerned that another federal or state agency would require that additional work be conducted after the ROD is implemented.

Response:

EPA makes every effort to incorporate or address all concerns of federal and state agencies to select final cleanup remedies. EPA will monitor the site to insure that the remedy remains protective. However, EPA does not regulate other agencies' actions

Comment:

8. A commenter expressed a concern for the decrease in property value of the homes in McIntosh. He indicated that he believed the two Superfund Sites in the town were the cause for the property value decrease and he wanted to know when would the site could be deleted from the NPL.

Response:

EPA is continuing to look for ways to make cleanups more efficient and cost effective. It is our goal to conduct quality cleanups in the shortest time possible. EPA will consider deleting the site as soon as protection of people and the environment have been achieved.

Comment:

A commenter indicated that the Health Department and EPA were giving conflicting information since the fish advisory issued by the health department discouraged eating large amounts of fish caught near the Olin Basin (adjacent to the Ciba-Geigy floodplain) and EPA has not indicated that the fish are significantly impacted.

Response:

The two agencies have different responsibilities. EPA's responsibility is to inform you of the impact the contamination from the site may have on the fish and to reduce risks related to the contaminants. The Health Department is responsible for determining if it is safe for you to eat the fish. Therefore, the two agencies provide information on different aspects of the contamination.

IV. Remaining Concerns

The community's concerns surrounding the Ciba-Geigy Site will be addressed in the following areas: continued community relations support of the ongoing Operable Unit #2 and %4 Remedial Design/Remedial Action (RD/RA) activities and community relations support for the upcoming Operable Unit #3 RD/RA activities.

Community relations will consists of making available final documents (i.e., Remedial Design Workplan, Remedial Design Reports,etc.) in a timely manner to the local repository. Also, issuance of fact sheets to those on the mailing lists will further provide the community with project progress and a schedule of events. The community will be made aware of any principal design changes made during the project design. If at any time during the RD/RA new information is revealed that could affect the implementation of the remedy or if the remedy fails to achieve the necessary design criteria, the Record of Decision may be revised through amendment or an explanation of significant difference to incorporate new Technologies that will attain the necessary performance criteria.

Community relations activities will remain an active aspect Throughout the remainder of the remedial activity at this Site.

APPENDIX B

CONCURRENCE LETTER

ADEM <IMG SRC 0495244H>

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
MAY 10 2 04 PM '95
REGIONAL BRANCH

Fob James, Jr.
Governor

John M. Smith, Director

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May 1, 1995

Mr. Charles L. King, Jr.
Remedial Project Manager
South Superfund Branch
U.S. Environmental Protection Agency
345 Courtland Street, NE
Atlant, GA 30365

RE: Ciba-Geigy Corporation Superfund Site
Draft Record of Decision
Operable Unit No. 3 - Floodplain

Dear Mr. King:

ADEM has reviewed the referenced Draft Record of Decision. Based on our review, we concur with the Draft Record of Decision without further comments.

If there are questions regarding this matter, please contact Mr. C. H. Cox of Special Projects at (334) 260-2785.

Sincerely,

<IMG SRC 0495244I>
John M. Smith
Director

SOUTH

SUPERFUND

<IMG SRC 0495244J>

APR 17 1 58 PM '95

STATE OF ALABAMA
DEPARTMENT OF PUBLIC HEALTH

DONALD E. WILLIAMSON, M.D. * STATE HEALTH OFFICER

April 14, 1995

Charles King, RPM
U.S. Environmental Protection Agency
Region IV, SSRB
345 Courtland Street, NE
Atlanta, Georgia, 30365

Dear Mr. King,

I appreciate the opportunity to review the Draft Record of Decision for Operable Unit #3 for the Ciba-Geigy Corporation Chemical Superfund Site, CERCLIS No. ALD001221902. The Alabama Department of Public Health (ADPH) concurs with the selected remedy (Alternative No. 3-Treatment of Excavated Soils Combined with In-Situ Bioremediation) for Operable Unit #3. ADPH feels that this method is both protective of human health and the environment.

If you have questions regarding our views of any of the selected remedies, please call me or Brian J. Hughes, Ph.D., at (334)613-5347.

Sincerely,

<IMG SRC 0495244K>
Neil Daniell
Geologist
Risk Assessment Branch

/nd

cc: Richard Kauffman